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To Advertisers

CHANGES for advertisements should be in this office by Friday noon for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than Monday noon to insure publication in that week's issue.

The American Institute of Electrical Engineers is fortunate in its friends. The exceedingly valuable gift of the Latimer Clark library recently made by Dr. S. S. Wheeler has just been duplicated by Mr. Andrew Carnegie—that is, duplicated in so far as its money value is concerned. This is a magnificent start toward the new house for the Institute, which is so necessary to the welfare and future expansion of that body. With these examples before them members should not hesitate to contribute liberally and subscribe toward the erection of this building. It is hoped and believed that the matter will be thoroughly discussed at the summer meeting of the Institute and that some definite step will there be taken toward its accomplishment.

ELECTRICAL EQUIPMENT FOR THE NEW YORK SUBWAYS.

So far no plans have been made public concerning the operating equipment of the railways which will soon traverse the tunnels now being constructed in New York city, under the direction of the Rapid Transit Commission. It is, of course, a foregone conclusion that these railways will be operated by electricity, but in the matter of their equipment there is opportunity for considerable difference of opinion and discussion.

The primary functions of the rapid transit tunnels are to move the greatest number of passengers with the utmost expedition consistent with safety, and rather to work in cooperation with the existing elevated and surface lines than to attempt any variety of competition with them. From the general details of the plan now being worked out, it is evident that the stations will be somewhat further apart than those of the elevated lines, making higher overall speeds easily possible. Provisions have also been made for express service in both directions on unobstructed tracks where the stopping points will be located at such distances apart that very high intermediate speeds may be attained. Singularly enough, there has been no apparent provision made for the utilization of these tunnels by the suburban service of railways entering New York city, either from the north by way of the Fourth avenue tracks and the Grand Central Station or from the east by a tunnel under the East River. There can be little doubt that the service of the tunnel trains will eventually be extended out to a considerable distance along the lines of the existing steam railways and will thus constitute an important factor in the electrification of such lines. It is much to be regretted that provision was not made for the construction of larger tunnels that would easily receive the standard passenger trains of the steam railways and permit through service with Brooklyn, for example, allowing the erection at some future time of a central passenger station in the downtown district of New York, whence trains might be taken for distant cities. As things stand now it seems likely that the extension of the subway system will take the form of operating the subway trains beyond the confines of the rapid transit commissioners' lines over connecting railway systems, and naturally this will require a unification of the methods of electricity supply and conductor construction, as well as train equipment over all of the connecting systems. With the rapid acceleration necessary to provide speedy service in tunnels it seems that direct current must be the agency used. Assuming that this will be so, the three points upon which opinion may differ widely are the voltage to be employed, the method of conductor installation, and the question of locomotives *versus* multiple-unit motor equipment.

It has often been noticed in these columns that tradition plays all too large a part in modern engineering practice. The standard pressure of 500 volts for electric railway service was adopted by Mr. Sprague, in 1887, as being the highest for which the apparatus of that day, and of the size that he desired to use, could safely be made. It became the standard for street railway practice, and still remains so, although to-day it is not a matter of particular difficulty to build direct-current motors of the sizes needed for heavy interurban work for twice that pressure. As twice the pressure means only one-fourth the weight of conducting metals needed for the same efficiency of operation, it is to be hoped that the new equipment will depart from tradition sufficiently to secure this radical and important benefit.

At the same time, the installation of a line pressure of 1,000 volts would so reduce the current necessary for operating trains as to make the use of an overhead

trolley system practicable—not only in the tunnels themselves, but on the suburban sections of the connecting steam railways as well. Putting the lines overhead at once removes the bugbear of danger from an exposed third rail and permits cheap and speedy extensions in the system wherever desired.

It is believed that the successful operation of the electric elevated railway system in Boston, Mass., will prove an object lesson determining the choice of a multiple-unit system for the new underground roads in New York.

CARBON.

The report of the Committee on Photometry of the National Electric Light Association, published in a recent issue of the ELECTRICAL REVIEW, justifies the conclusion that American arc lamp carbons are now as good as the best grade of imported carbons for use in enclosed arc lamps. Comparatively wide differences in various qualities exist between different types of carbons, both of American and foreign manufacture, but it seems just to conclude that a fair average of both the German and American carbons is about the same. This is a highly satisfactory state of things but there is no reason to suppose that the advance which has been made in the United States in the art of carbon making in the last fifteen years will stop at the present point. The materials necessary for the process are to be had here of most excellent quality and in quantity sufficient to insure relatively low price in the manufactured product. It is more important than many are accustomed to think that we should be in a position to dispense with imported goods of all kinds. Conditions may easily arise that will make this perfectly evident, and it is, therefore, a subject for congratulation that American carbon makers are now turning out product as good as any that is made in the world.

Mr. Marconi's paper on wireless telegraphy, concluded in this issue of the ELECTRICAL REVIEW, gives an excellent idea of the great amount of experimental work recently undertaken in that field, and incidentally shows that marked advances in the direction of syntonic systems have been made.

CONCERNING CONVENTIONS.

This is a great country for conventions. All through the summer months the representatives of a great number of trades and professions, as well as people of kindred interests of various kinds, meet at some stated place to hear papers read, to transact business of one kind or another and to discuss matters, both formally and informally. The custom, which all agree is a good one, seems to be spreading, and every year these conventions, especially those in the electrical and mechanical trades, are more interesting and of more importance and value to those taking part. One factor, however, which is apparent to the close observer of such meetings, seems not to be generally understood by those having convention matters in hand. This is that it is unwise to attempt the holding of convention sessions in the face of great attractions, tending to distract the attention of the delegates and to cause them to desert the meetings. If one will examine the history of convention meetings and attendance of any of the various associations, more particularly in the field of applied electricity and mechanics, he will note that where these have been held at watering-places, or in small cities where there were no overpowering counter attractions present, they have universally been successful. When, however, they have been held in great cities like New York and Chicago, where there are manifold things and happenings to divert the attention of the delegates, it has been found difficult generally to keep the members together and make them attend the sessions. In general it may be concluded that the best place for convention holding is one that combines natural beauty, good accommodations and an absence of features tending to distract those in attendance. An exposition or a great city has no compensating advantages compared with those offered by a retired watering-place. A few years ago one of the most progressive and vigorous of the electrical associations held its convention on a steamboat, chartered for the occasion, while traversing the Great Lakes. The convention was a pronounced success, as might naturally have been supposed.

A NEW FIELD FOR ELECTRICITY.

There was in session last week, at Philadelphia, a convention of delegates from various parts of the southern states seeking to better the acquaintance of merchants and capitalists of that city with the resources of the states they represented. While nothing particularly new was brought out in the statements made by the various speakers, yet the evidence adduced regarding the climatic, geographical and topographical aspects of this section of the country was such as to call peculiar attention to the importance of establishing electrical power development plants in it. The main line of the Appalachian range extends in an almost unbroken chain from Maine to Alabama, ending in the latter state. On the east flank of these mountains in Virginia, the Carolinas and Georgia, and on the west flank, in West Virginia, Tennessee and Alabama, are some of the finest water powers in the United States, situated near deposits of minerals of many different kinds and of great value, and in the midst of forests which are yet practically untouched. Navigable rivers run from the seaboard to the foothills of the mountains, while the railway systems of the various states mentioned are excellent. There is thus every condition which leads to profitable development of natural power resources in this territory, but with those that are mentioned is combined another whose value, perhaps, requires experience to appreciate.

With the comparatively equable climate of the southern seaboard and its short and mild winters these water powers are perpetual. The winters are not cold enough to cause troublesome ice to form, while the rainfall is distributed through the year so that at all seasons an abundant supply of power is assured. Under these circumstances it is not unwise to look forward to the section indicated as one which will see great electric power developments in the course of the next few years. Already at a number of places steps have been taken to begin this work and it is earnestly hoped that they will be carried forward to a successful conclusion. Among many other natural advantages, the southern states have none of more importance to them and to their future than the water powers now running to waste in their hills.

THE THEORY OF ALTERNATING DYNAMO ELECTRIC MECHANISMS—XXXI.

BY W. ELWELL GOLDSBOROUGH.

So far nothing has been said regarding the locus of the line currents. The several values of the line current are equal to the resultants of the several pairs of branch currents that correspond to successive values of x_2'; consequently OB^b is the resultant of $OB_{2_i}{}^b$ and OB^a, and OB^c is the resultant of $OB_{2_i}{}^c$ and OB^a.

The total resistance electro-motive force of the system can be determined by extending the current vectors until they meet projections from like vector head points on the line impedance electro-motive-force circle. Corresponding to the several line currents, therefore, the total resistance electro-motive-force vectors OC^a, OC^b, etc., are determined.

It is interesting here to call to mind the fact that the locus curve of the total line current is a circle of the same diameter as the locus circle of the current I_2'. It is, however, displaced above the latter in such a way that the smallest value of the total line current is equal to the constant current I_2'' flowing in the circle $O''A''$.

The locus followed by the heel of the electro-motive-force triangle of the complete system is the curve $C^aC^bC^cC^d$ $C^eC^fC^a$, which is symmetrically located with reference to the vector OA_1.

When the reactance of the circuit $O'A'$ is zero the branch currents have the values OB^a and $OB_{2_i}{}^d$, while the line current has the value OB^d. All of these vectors are in phase with the electro-motive force OA_1. The electro-motive force which must be developed by the generator to set up this maximum line current is equal to OA^d.

As the reactance of the circuit $O'A'$ is again made apparent by the introduction of a capacity reactance (see Fig. 84) the current I_2' assumes positions in advance of OA_1, and the resultant vector quantities have, for instance, the values and phase positions designated by the exponent letters *e* and *f*. Following the construction we find that when x_2' is given a value that results in $I^{2'}$ being equal to OB_e, the main line current has a value OB^e, and the generator electro-motive force a value OA^e. As the capacity reactance is still further reduced the current in the circuit $O'A'$ has a diminishing value.

After reaching the phase positions indicated by exponent letter *f*, if still further reductions are made in C_2' (the capacity of the condenser in $O'A'$) the vector heads will pass along over the various loci curves until the initial positions indicated by the exponent letter *a* are returned to.

Some very interesting facts are brought

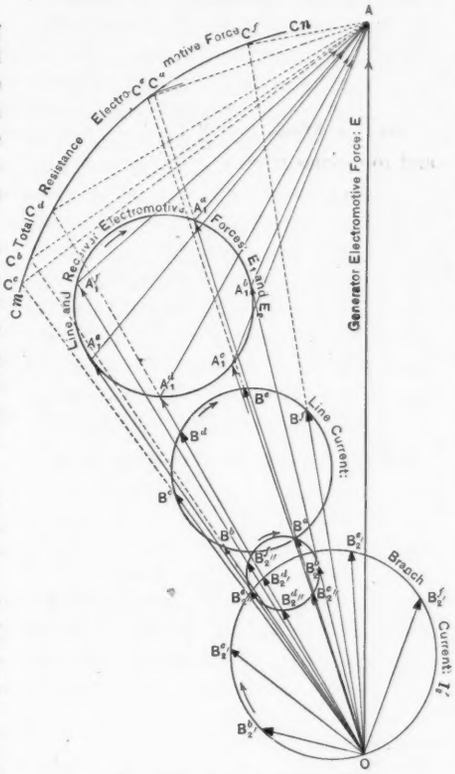


FIG. 86.—ALTERNATING MECHANISMS.

about by the vector diagram of Fig. 85. Tracing the cycle of events by means of exponent letters, we see that, as the initial infinite inductance reactance is diminished, there is a very rapid increase in the angle of lag of the line current behind the generator electro-motive force. When, however, the line current has

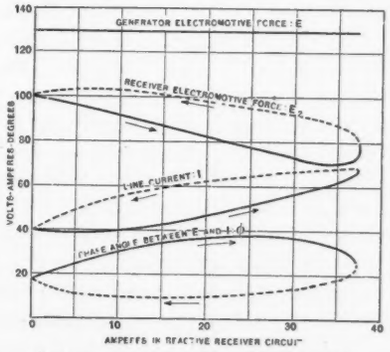


FIG. 87.—ALTERNATING MECHANISMS.

passed a value midway between B^b and B^c, any further decrease in the inductance reactance causes the angle of lag between the line current and generator electro-motive force to gradually decrease; and, finally, when the line current has passed around its locus circle to the point B^f the line current and generator electro-motive force are quite nearly in phase. For very small capacity reactance values the lag of the current behind the generator electro-motive force again increases and ultimately returns to its initial value when $C_2' =$ zero. The generator electro-motive force is greatest when the line current has a position between the points B^e and B^d, and its least when the line current has a position between B^f and B^a. Under ordinary commercial conditions, as is quite evident, leading currents in the circuit OA_1 have the effect of reducing the generator electro-motive force, whereas lagging currents in the circuit OA_1 have the effect of augmenting the generator electro-motive force, if it is desired to maintain a constant pressure at the terminals of the receiver circuit. This is so important a point that it is well to emphasize it. It has, in fact, a broad bearing upon the problem of the operation of synchronous and induction motors in connection with lighting circuits.

Before leaving the discussion of Fig. 85 it may be well to trace out one of the vector diagrams that depends upon the presence of a capacity reactance in the circuit $O'A'$. Take, for example, that value x_2' which gives rise to the current OB_f. This current would produce, when flowing over the line by itself, a line impedance electro-motive-force triangle OC_fA_f. Now the current OB^a, flowing in the circuit $O''A''$, produces the line impedance electro-motive-force triangle $OC_{2_a}A_{2_a}$, when considered without reference to other line currents. Taking the resultant, therefore, of OA_f and OA_{2_a} in connection with the vector OA_1 we locate the point A_f on the line impedance electro-motive force locus circle; therefore, the generator electro-motive force at this time must be equal to OA^f and the line current have a value OB^f, equal to the resultant of OB^a and $OB_{2_i}{}^f$.

From Fig. 85 we will now develop the vector diagram showing the regulation that will take place at the terminals of the receiver circuit when the generator electro-motive force is kept constant at a value equal to OA^a. To do this the several vector diagrams indicated by the different exponent letters must be reduced in the ratio of the vector OA^a to the generator electro-motive forces by which they are influenced. By this process the vector diagram shown by the exponent letter *a* remains unchanged. The vectors of the diagram shown by the exponent letter *b* are all reduced in value in the ratio of OA^a to OA^b. And the vectors of the diagram represented by the exponent letter *e* must correspondingly be reduced in the ratio of OA^a to OA^e, and so on for the other diagrams.

After these diagrams are reduced they must be superposed in such a way that the now equal generator electro-motive-force vectors will fall one upon another. The results of this proportional reduction and superposition are shown in Fig. 86. The exponent letters indicate quite readily and clearly the new positions, relatively to one another, which are taken by the various vector quantities.

By Fig. 86 we see that the heel of the electro-motive-force triangle of the whole system moves back and forth along the arc $C_m C^e C_n$, whereas previously it followed the half-moon shaped locus curve at the top of Fig. 85. The locus now traversed jointly by the vector head of the receiver electro-motive-force vector, and the heel of the line impedance electro-motive-force vector is the circle $A_1^a A_1^b A_1^c A_1^d A_1^e A_1^f$, the proportional reduction in the vector lengths not having affected the character of the locus curve which links together the generator electro-motive force, the receiver electro-motive force and the line electro-motive force. More than this, we find that the locus curve now followed by the line current also retains its circular form, and the same can be said of the locus curve traced by the branch current flowing in the circuit O'A'.

Since now the receiver electro-motive force varies, the current in the circle O''A'' must necessarily also be a variable, varying proportionally with E_2. It also, therefore, traces out a locus curve that is a circle, as shown by the curve $B_{2_u}^a B_{2_u}^c B_{2_u}^d B_{2_u}^e B_{2_u}^a$. To see the connection between the three-current loci curves it must be remembered that the line current is always the resultant of two branch currents; consequently, we find that OB^e is equal to the vector sum of $OB_{2_l}^e$ and $OB_{2_u}^e$, since the distance $B_{2_u}^e B^e$ is equal to $OB_{2_l}^e$. In the same way, the vector OB^b is equal to the vector sum of $OB_{2_l}^b$ and $OB_{2_u}^b$, since, likewise, $B_{2_u}^b B^b$ is equal to $OB_{2_l}^b$.

An Electrical Museum.

The British Institution of Electrical Engineers has at present under consideration the formation of a museum for electrical apparatus or objects of types not now in commercial use but possessing historical interest. Many persons must have in their possession such apparatus, and to prevent the irretrievable loss to the profession which would be occasioned by the destruction of these an invitation has been issued to the members of the Institution and their friends to cooperate in the collection or cataloguing of such specimens as may be available. The authorities of the South Kensington Museum, London, have promised to receive such of the objects as may appear to be of sufficient public interest.

Science Brevities

Slotting and Drilling by Electrolysis—Mr. S. Cowper-Coles has accomplished some curious and interesting results in the drilling and slotting of metals by electrolysis. The process greatly resembles the sand blast. A jet of an electrolyte, either dilute sulphuric acid or a solution of common salt, is directed at the object to be drilled, the latter being the anode while the nozzle of the jet is the cathode. A fairly powerful current is used and the object is dissolved away in the line of the jet. In recent forms of the apparatus the nozzle is brought very close to its work and the size and shape of the hole are defined by a stencil plate of soft india rubber.

Calcium Carbide as a Reducing Agent—Some specimens of copper and alloys, exhibited last year at Paris by Siemens & Halske, of Berlin, were examined with interest, because they had been reduced with the aid of calcium carbide from oxides and chlorides. Commercial calcium carbide is not yet 10 years old. It is manufactured in more than half a hundred works, the problems of its production have satisfactorily been solved, and if we only knew what to do with it, it might still be regarded as a most promising child. But it remains practically simply the parent of acetylene, which dazzles more than it pleases, says *Engineering*. Other applications from the carbide are needed. That it should be a powerful reducing agent could be anticipated from its composition, and Fröhlich, Gelmuyden, Moissan, Neumann, Tarugi and Warren, among others, have investigated its metallurgical capabilities. To this list must now be added Fr. von Klügelgen, who publishes a long paper in the *Zeitschrift für Elektrochemie*. Klügelgen uses clay crucibles and a commercial carbide which contained 88 per cent of CaC_2. He first tried lead oxide. When equivalent proportions of oxide and calcium carbide are mixed the reduction starts at dark red glow and yields only carbon dioxide; with an excess of carbide, carbon monoxide also makes its appearance. The chief agent appears to be the calcium; the carbon comes in more secondarily, especially when the mass is heated to high temperatures. This is proved by the fact that finely divided carbon is found in the mass when the reaction remains incomplete, as it frequently does; and this carbon has a decidedly detrimental influence, because it prevents the fusion and the union of the reduced metallic particles. Further, calcium carbide is decomposed when heated alone, and the calcium is transformed into oxide and carbonate. It is hence advisable to conduct the experiments under a layer of fused sodium chloride or calcium chloride, which may, however, destroy the crucibles. With lead oxide the reaction is not sufficiently energetic to proceed by itself. With chloride, however, it is explosive. Mixtures of chloride and oxide in suitable proportions, provided with a core of chloride and carbide to act as a primer, need not be heated from outside, and gave a good yield of metallic lead, up to 92 per cent. The lead contains only very little calcium; when a large excess of carbide is applied the calcium percentage may rise to one per cent and above. Copper oxide reacts more energetically than lead oxide; a more quiet process results when calcium chloride, fused previously in an iron crucible, is poured over the mixture. A mixture of carbide and copper chloride behaves like an explosive. But the copper regulus obtained is comparatively small. A great deal of the copper is separated as a powder, which the heat, owing partly to the liberation of carbon, is unable to melt, though it destroys the crucibles and throws the mass about. In mixtures of copper and zinc salts, some reduced zinc is burned again during the latter stages of the process, and the preparation of other alloys was not very successful. The yield of tin was poor, molybdenum, tungsten, chromium, iron, nickel were obtained as powders containing carbon; bismuth would easily be reduced in a satisfactory way, the alkali hydrates likewise, the chlorides less so; aluminum oxide and chloride gave trouble. The researches demonstrate that calcium carbide can undoubtedly afford a very valuable help to the chemist and assayer; and also to the metallurgist in refining operations. But its direct metallurgical value has not yet been established, and can hardly be determined, in our opinion, by laboratory experiments conducted with materials considerably less than a pound in weight. The quantity of carbide worked varies, but can not be neglected. An objection, raised indirectly by Moissan, that these reductions generally lead to the formation of metallic carbides—which he, in fact, generally wished to prepare—requires, however, modification. The carbides generally form at higher temperatures, and lower temperatures are, for many reasons, preferable for these reactions. On the whole, reduction by calcium carbide is more likely to yield a metal free from carbon than the reduction by means of coal.

SYNTONIC WIRELESS TELEGRAPHY—II.

(Concluded.)

BY GUGLIELMO MARCONI.

As I pointed out before, a transmitter consisting of a vertical conductor as shown in Fig. 1 is not a very persistent oscillator. Its electrical capacity is comparatively so small and its capability of radiating waves so great that the oscillations which take place in it must be considerably damped. In this case receivers or resonators of a considerably different period or pitch will respond and be affected by it. From the results obtained it would seem as if the transmitter were sending out a great variety of electric waves, resembling, therefore, a source of white light, and that each resonator picks out and responds to its own particular wave-length.

This view, however, is incorrect; the fact that, given certain conditions, various resonators will respond, even if their period be different from the natural period of oscillation of a transmitter, is to be accounted for by the consideration that all the energy of the transmitter is radiated in only one or two swings, with the result that oscillations may be induced in resonators of different periods, while, if the same amount of energy be distributed in a great number of individual feeble impulses, their

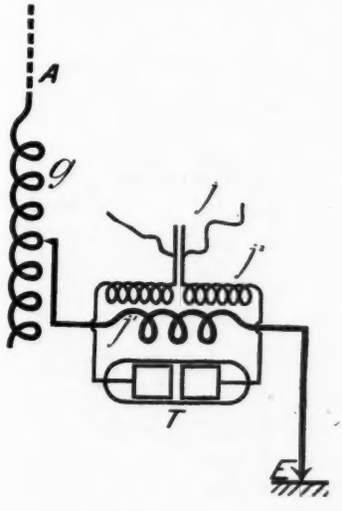


FIG. 9.

combined effect can only be utilized or detected by a resonator tuned so as to respond to their particular frequency. The tuned resonator will not then respond to the first two or three oscillations but only to a longer succession of properly timed impulses, so that only after an accumulation of several swings the electro-motive force becomes sufficient to break down the insulation of the coherer, and cause a signal to be recorded.

Notwithstanding the disadvantages for obtaining electrical tuning, attributed to the form of transmitter shown in Fig. 1, selection of messages is possible, when using, say, two or three transmitters, having wires of considerably different lengths, and the induction coil or oscillation transformers on the receivers wound with varying lengths of wire in their secondary circuits, in order to cause them to be in tune or resonance with the length of wave of the transmitted oscillations as pointed out in my British patent, No. 12,326, dated June 1, 1898. At page 1, line 19, this reads: "It is desirable that the induction coil should be in tune or syntony with the electrical oscillations transmitted, the most appropriate number of turns and most appropriate thickness of wire varying with the length of wave transmitted."

The following experiment, which has

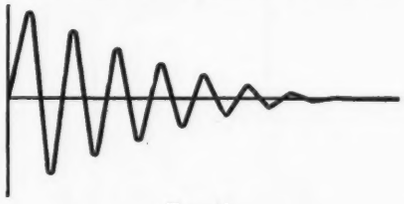


FIG. 10.

been successfully tried, proves this point. At St. Catherine's, Isle of Wight, we have a transmitting station having a vertical wire 45 metres long, and at sea, 16 kilometres from our receiving station at Poole, a ship with transmitting wire of 27 metres. It is, therefore, obvious that the wave-length of the electric oscillations radiated from St. Catherine's differed considerably from that radiated from the ship. Now, if at the receiving station at Poole we connected to a vertical wire two receivers, one having an induction coil with secondary in tune with the length of wave emitted by St. Catherine's, and the other with that emitted by the 27-metre feet wire on the ship; if St. Catherine's and the ship transmit simultaneously two different messages, these will be picked up at Poole, and each message will be reproduced distinctly on its receiver.

I pointed out in a patent specification, dated December 19, 1899, No. 25,185, page 2, that the best results are obtained when the length of wire of the secondary of the induction coils is equal to the length of the vertical wire used at the transmitting station, therefore the length of the secondary of the receiving induction coils was made equal to that of the transmitting wire. (Something of the same kind has been lately noticed by Professor Slaby in what he calls an extension wire.)

These results, although in a way satisfactory, did not appear to my mind a complete solution of the problem. I found it impossible to obtain the two messages at the receiving station, if the two transmitting stations were placed at equal distances from it. The following considerations may perhaps explain this failure. If the 27-metre transmitting wire was placed at the same distance from Poole as the 45-metre one, *i. e.*, 50 kilometres, the waves emitted by the 27-

FIG. 11.

metre wire would be too weak when they reached Poole to affect the receiver. On the other hand, if the 45-metre transmitter was placed at 16 kilometres from the receiver, then the waves radiated by it would be so strong as to affect the receiver tuned to respond to the 27-metre transmitter and blur its signals.

It thus became apparent that some different form of less damped radiator was necessary, in order to obtain more practical and more useful results.

I carried out a great number of experiments by adding to the radiating and receiving wires inductance coils, on a principle to that suggested by Lodge in his 1898 patent (No. 29,069), but without obtaining any satisfactory results. The failure was probably due to the fact that the electrical capacity of the exposed conductors became too small in proportion to their inductance. I then tried various methods for increasing the capacity of the radiating system. The first and obvious mode of effecting this is by an augmentation in the size of the exposed conductor, but this method is not entirely satisfactory, in consequence of the circumstance that an increased surface means increased facility for radiating the energy during the first oscillations, and also because large plates or large exposed areas are impracticable on board ship, and are always difficult to suspend and maintain in good position during windy weather. The way out of the difficulty was discovered by adopting the arrangement shown in Fig. 3. Here, we have an ordinary vertical radiator placed near an earthed conductor, the effect of the adjacent conductor being obviously to increase the capacity of the electrical radiating wire without in any way increasing its radiative power, and, as I had expected, syntonic results were not difficult to obtain with such an arrangement.

Mention of this method has been made by Captain Ferrie, one of the members of the French Commission which was present at the tests carried out across the English Channel in 1899, in a paper on wireless telegraphy. See paper "Etat Actuel et Progès de la Telegraphie Sans Fil" read

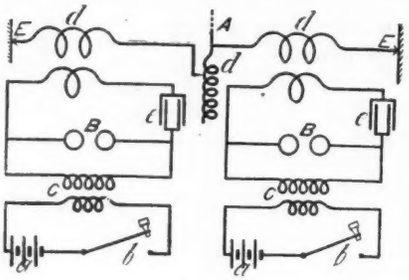


FIG. 12.

before the Congrès International d'Electricité, Paris, 1900.

Satisfactory results were obtained and I was encouraged to continue my researches in order to improve the system.

Early in 1900 I obtained very good results with the arrangement shown in Fig. 4. This arrangement is fully described in a British patent application applied for by myself on March 21, 1900, No. 5,387. In it the radiating and resonating conductors take the form of a cylinder, the earthed conductor being placed inside. This form of radiating and receiving areas is much more efficient than the one I have previously described. One necessary condition of this system is that the inductance of the two conductors should be unequal, it being preferable that the large inductance should be joined to the non-earthed conductor. I presume that in order to radiate the necessary amount of energy, it is essential that there should be a difference in phase of the oscillations in the two conductors, as otherwise their mutual effect would be to neutralize that of each other. In the first experiments mentioned by Captain Ferrie, this was obtained by simply using an earthed conductor shorter than the radiating or resonating one. When I used an inductance between the spark-gap or oscillation producer and the radiating conductor, I found it possible to cause the electrical period of oscillation of the receiving cylinder to correspond to that of one out of several transmitting stations, from which one alone it would receive signals. The results obtained by this system have been remarkable. By using cylinders of zinc only seven metres high and 1.5 metres in diameter, good signals could easily be obtained between St. Catherine's, Isle of Wight, and Poole (distance, 50 kilometres), these signals not being interfered with or read by other wireless telegraph installations worked by my assistants or by the Admiralty in the immediate vicinity. The closely adjacent plates and large capacity of the receiver cause it to be a resonator possessing a very decided period of its own, *i. e.*, it becomes no longer apt to respond to frequencies which differ from its own particular period of electrical oscillation, nor to be interfered with by stray ether waves which are sometimes probably caused by atmospheric disturbances, and which occasionally prove troublesome during the summer.

It seemed very remarkable to me during my first test that an arrangement similar to that shown in Fig. 4 should prove to be

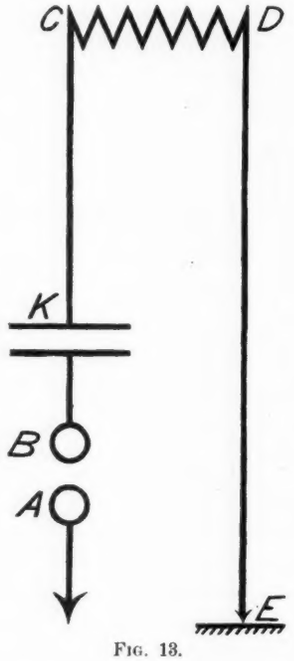


FIG. 13.

a good radiator and should enable such a considerable distance to be achieved with cylinders of so moderate a height. It is probable that the great majority of the electrostatic lines of force pass directly from one cylinder to the other, but it must be also true that a certain number leave the outer part of the external cylinder, exactly as in the case of an ordinary radiator.

The receiver is not shown in the sketch, but consists of similar cylinders to those used for transmitting the receiving induction coil or oscillation transformer, being placed where the spark-gap is shown in Fig. 4.

The capacity of the radiator due to the internal conductor is, however, comparatively so large that the energy set in motion by the spark discharge can not all radiate in one or two oscillations, but forms a train of slowly damped oscillations, which is just what is required. A simple vertical wire, as shown in Fig. 1, may be compared with a hollow sphere of thin metal, which, when heated, would cool very rapidly, and the concentric cylinder system with a solid metal sphere would take a very much longer time to cool.

Mr. W. G. Brown suggested, in a patent specification dated July 13, 1899, No. 14,449, the use of two conductors of equal length joined to each side of the spark-gap, but he did not describe the inductance in series between them and the spark-gap, which, according to my experience, is absolutely essential for long-distance work.

Another very successful syntonized transmitter and receiver system was the outcome of a series of experiments carried out with the discharge of Leyden jar circuits. Taking for granted that the chief difficulty with the old system, as shown in Fig. 1, lies in the fact, as already stated, that the oscillations are very dead beat, I tried by means of associating with the radiator wire a condenser circuit, which was known to be a persistent oscillator, to set up a series of persistent oscillations in the transmitting vertical wire.

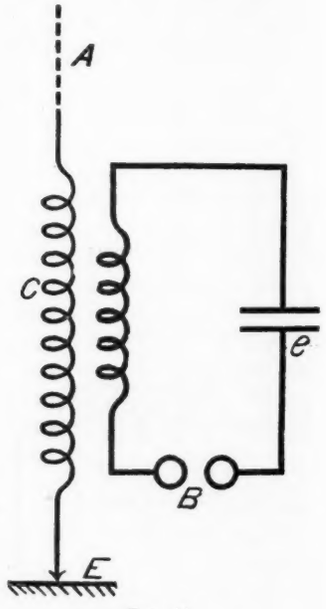


FIG. 14.

An arrangement as shown in Fig. 6, which consists in a circuit containing a condenser and a spark-gap, constitutes a very persistent oscillator. Professor Lodge has shown us how, by placing it near another similar circuit, it is possible to demonstrate interesting effects of resonance by the experiment usually referred to as that of Lodge's syntonic jars.

But, as Lodge points out,* "A closed cir-

* The Work of Hertz, by O. J. Lodge, page 7.

cuit such as this is a feeble radiator and a feeble absorber, so that it is not adopted for action at a distance." I very much doubt if it would be possible to affect an ordinary receiver at even a few hundred yards. It is very interesting to notice how easy it is to cause the energy contained in the circuits of this arrangement to radiate into space.

It is sufficient to place near one of its

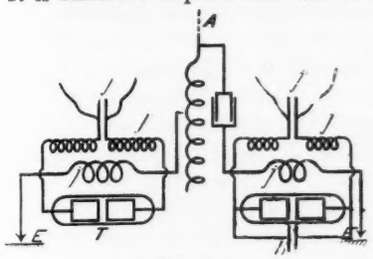


FIG. 15.

sides a straight metal rod or good electrical radiator; the only other condition necessary for long-distance transmission is that the period of oscillation of the wire or rod should be equal to that of the nearly closed circuit.

Stronger effects of radiation are obtained if the radiating conductor is partly bent around the circuit including the condenser (so as to resemble the circuits of a transformer).

I first constructed an arrangement as shown in Fig. 14, which consists of a Leyden jar or condenser circuit in which is included the primary of what may be called a Tesla coil, the secondary of which is connected to the earth or aerial conductor. The idea of using a Tesla coil to produce the oscillations is not new. It was tried by the post office officials when experimenting with my system in 1898, and also suggested in a patent specification by Dr. Lodge, dated May 10, 1897, No. 11,575, and by Professor Braun in the specification of a patent dated January 26, 1899, No. 1,862. My idea was to associate with this compound radiator a receiver tuned to the frequency of the oscillations set up in the vertical wire by the condenser circuit. My first trials were not successful in consequence of the fact that I had not recognized the necessity of attempting to tune to the same period of oscillation (or octaves) the two electrical circuits of the transmitting arrangement (these circuits being the circuit consisting of the condenser and primary of the Tesla coil or transformer, and the aerial conductor and secondary of the transformer).

Unless this condition is fulfilled, the different periods of the two conductors create oscillations of a different frequency and phase in each circuit, with the result that the effects obtained are feeble and unsatisfactory on a tuned receiver. The syntonized transmitter is shown in Fig. 7. The period of oscillation of the vertical conductor, A, can be increased by introducing turns, or decreased by diminishing their number, or by introducing a condenser in the series with it. The condenser, C, in the primary circuit is constructed in such a manner as to render it possible to vary its electrical capacity. The receiving station arrangements are shown in Figs. 8 and 9.

Here we have a vertical conductor connected to earth through the primary of a transformer, the secondary circuit of which is joined to the coherer or detector. In order to make the tuning more marked, I place an adjustable condenser across the coherer in Fig. 9. Now, in order to

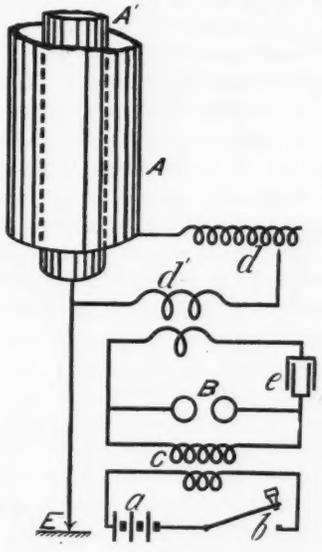


FIG. 16.

obtain the best results, it is necessary that the free period of electrical oscillations of the vertical wire primary of transformer and earth connection should be in electrical resonance with the second circuit of the transformer, which includes the condenser, h'.

I stated that in order to make the tuning more marked I placed a condenser across the coherer. This condenser increases the capacity of the secondary resonating circuit of the transformer, and in the case of a large series of comparatively feeble but properly timed electrical oscillations being received, the effect of the same is summed up until the electro-motive force at the terminals of the coherer is sufficient to break down its insulation and cause a signal to be recorded.

In order that the two systems, transmitter and receiver, should be in tune, it is necessary(if we assume the resistance to be very small or negligible) that the product of the capacity and inductance in all four circuits should be equal. A more complete and detailed description of this system is given in a British patent granted to me, dated April 26, 1900, No. 7,777. I have recently found that Professor Braun has recognized the necessity of tuning the circuits of the transmitter and receiver when using a Tesla coil in order to obtain syntonic effects, but I am not aware that such a proposal was published prior to the description given in the above-mentioned patent.

Although little difficulty has been encountered in measuring the capacity used in the various circuits, the measurement or calculation of the value of the inductance is not so easy. I have found it impracticable by any of the methods with which I am acquainted directly to measure the inductance of, say, two or three small turns of wire. As for calculating the inductance of the secondary of small transformers, the mutual effect of the vicinity of the other circuits and the effects due to mutual induction greatly complicate the problem.

Experiments have confirmed the fact that the receiving induction coils having the secondary wound in one layer and at a certain distance, say two millimetres (to cause the capacity to be so small as to be negligible), have a time period approximately equal to that of a vertical conductor of equal length (see patent granted to G. Marconi, dated December 19, 1899, No. 25,186).

If, therefore, we are using an induction coil having a secondary 40 metres long on the receiver, I should use a vertical wire 40 metres long at both trans-

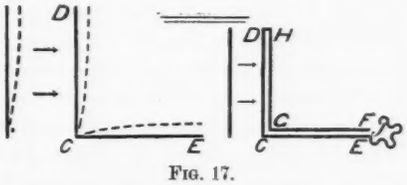


FIG. 17.

mitting and receiving stations. By so doing, I have the two circuits at the receiving station in tune with each other, and I only have to adjust the capacity of the condenser at the transmitter, which can easily be done, either by means of a condenser having movable plates that can be slid, more or less, over each other, or by adding or removing Leyden jars.

If we start with a very small capacity which we gradually increase, a value of the capacity will be reached, which will cause signals to be recorded on the receiver. Supposing the receiving system to be within the sphere of action of the

transmitter, then the signals will be strongest when the capacity of the condenser, *c* is of a certain value. If we still increase the capacity, the signals will gradually die away, while if we go on increasing the capacity, and, at the same time, add inductance to the aerial, to keep it in tune with the condenser jar circuit, we are still radiating waves, but these do not affect the receiver. If, however, at the receiving station we add inductance or capacity to the wire, A, Fig. 9, and also to the ends of the secondary, J_2, we find ourselves able to receive messages from the transmitter although we are utilizing waves of a different frequency.

It is easy to understand that if we have several receiving stations, each tuned to a different period of electrical vibration, and of which the corresponding inductance and capacity at the transmitting station are known, it will not be difficult to transmit to any one of them, without danger of the message being picked up by the other stations for which it is not intended. But, better than this, we can connect to the same vertical sending wire, through connections of different inductance, several differently tuned transmitters, and to the receiving vertical wire a number of corresponding receivers. Different messages can be sent by each transmitter connected to the same radiating wire simultaneously, and received equally simultaneously by the vertical wire connected to differently tuned receivers. This result, which I believe to be quite novel, I showed to several friends of mine, including Dr. Fleming, F.R.S., in the summer of last year, and to an Admiralty Commission. Dr. Fleming has made mention of the results I showed him in a letter to *The Times*, dated October 4, 1900, and in his Cantor lectures delivered before the Society of Arts in November and December, 1900. A further improvement has been obtained by the combination of the two systems. In this case the cylinders are connected to the secondary of the transmitting transformer, and the receiver to a properly tuned induction coil, and all circuits must be tuned to the same period as already described. (See Figs. 12 and 15.)

The tuning of the receiver to respond to the period of the transmitter, as used in the old form of transmitter, shown in Fig. 1, or in the new one, shown in Fig. 7, has enabled results to be obtained over considerable distances with moderate heights.

As already published by Dr. Fleming, in the letter above referred to, signaling has been successfully carried out over a distance of 50 kilometres with a cylinder only 1.25 metres high, 40 cm. in diameter. This has led to the possibility of constructing portable apparatus for army purposes, which should be of great service in the field. I have succeeded in constructing a complete installation on a steam motor car, of which I here show a photograph. On the roof of the car, as you may observe, there is placed a cylinder which can be lowered when traveling, its height being only six or seven metres, and by this means communication has been easily carried out with a syntonized station over a distance of 50 kilometres.

A 25-centimetre-spark induction coil, worked by accumulators and taking about 100 watts, is used for transmitting, and the accumulators can be recharged by a small dynamo worked by the car motor. I believe such an appliance might have been of use to the besieged garrisons in South Africa and China.

A strip of wire netting laid on the ground is sufficient for earth connection, and by dragging it along communication can be established even when the car is traveling. I have recently obtained as good results by not using any "connection" to earth, but only utilizing in lieu of earth the electrical capacity of the boiler of the motor car. I also find that signals can be transmitted a considerable distance with the cylinder in a horizontal position.

Last spring I recognized the desirability of carrying out tests between stations situated at much greater distances apart than had been attempted heretofore. A station was established at the Lizard, Cornwall, and on the first attempt communication was effected with St. Catherine's, Isle of Wight, over a distance of 300 kilometres, which, I believe, is the record distance over which signals have been sent through space without wires. It is interesting to observe that signals were obtained over this distance with the transmitting apparatus as shown in Fig. 1, or with the arrangement shown in Fig. 7, provided always that a suitable resonating induction coil was employed at the receiving station.

The amount of energy used for signaling over this distance is not more than 150 watts, but experiments with a larger amount of energy will shortly be carried out. In the case of the 300-kilometre transmission, the aerial conductor consisted of four parallel vertical wires, 1.50 metres apart, 48 metres long, or in a strip of wire netting of same length.

It is interesting to note that in order to communicate between my stations at Poole and St. Catherine's (distance, 50 kilometres), with the same amount of energy and the same kind of aerial wire, this must be 20 metres high to obtain signals of about the same strength as those obtained between the 300-kilometre stations with the 48-metre aerials.

This goes to confirm many other results previously obtained, which indicate that with a parity of other conditions the distance varies with the square of the height of the vertical conductors at the two stations. I have always found this law fulfilled, if the height of the conductors at the two stations is approximately equal, although an attempt has been made recently to throw doubt upon its correctness.

You will admit that the progress achieved in syntonic space telegraphy must have enormously increased its field of application and usefulness, since a very great number of non-interfering stations can now be worked in the immediate vicinity of each other.

It will probably be of interest if I give you a few examples of the progress made in the practical utilization of my system. An eminent electrician recently expressed a doubt whether there was at present a single circuit worked commercially on a practical system of wireless telegraphy.

If earning a revenue from working installations can be termed a commercial working, even such an incomplete list of these as time will now permit me to give you, and which are now all in permanent working order, may be sufficient proof that a beginning, at least, has been made in the commercial utilization of the system.

In March, 1900, there were in use in the Royal Navy, in South African waters, five installations of my system. The Admiralty was apparently well satisfied with its working, since in May of last year they decided to extend its adoption to 32 more ships and land stations. The conditions of the contract were that each apparatus, before being accepted, should be satisfactorily worked by naval signalmen between two ships anchored at Portsmouth and Portland, over a distance of 100 kilometres, a considerable portion of which, *i. e.*, 30 kilometres, lies overland, with intervening hills, and the height of aerial wire was specified not to exceed, on each ship, 49 metres. The apparatus was delivered in a comparatively short time, no sets having been found unsatisfactory. The apparatus supplied to the Admiralty is, so far, all of the old pattern, *i. e.*, the non-syntonized system; and I have been informed that messages have been trans-

mitted and received by naval signalmen between ships more than 160 kilometres apart. It sometimes occurs that the unfamiliarity of the operators with the particular kind of apparatus used caused unsatisfactory results to be obtained, but I believe this trouble will soon disappear. I am glad to be able to state that arrangements are being made to install my new syntonic apparatus upon several of His Majesty's ships. I believe that in no other navy in the world is wireless telegraphy being worked regularly over such considerable distances. My system is also used for communication between the Borkum Riff and Borkum Lightship, in Germany, where an ordinary commercial charge is made for messages received from ships, and it is employed further on the Nord Deutscher Lloyds mail steamer Kaiser Wilhelm der Grosse.

According to an official report of the Imperial postal authorities at Oldenburg, the total number of commercial wireless telegrams transmitted from and to the lightship between May 15 and the end of October amounted to 565, and of these 518 came from ships at sea, while 47 were transmitted to ships. Of the 518 telegrams, 35.7 per cent were addressed to the North German Lloyd and 64.3 per cent to other shipping firms.

The installations are worked by ordinary operators in a most satisfactory manner, and, on one occasion, assistance was obtained for a man who was taken suddenly ill on the Borkum Riff, and it was thus made possible to hand him over promptly for medical treatment on shore.

The system has been in operation at La Panne, near Ostend, and on the Belgian mail steamer, Princess Clémentine, which plies to Dover. With a height of only 22 metres on the ship it has been found practicable to communicate from Dover Harbor to La Panne, 75 kilometres away, and this installation has proved of value in saving life and property. Thus recently a bark was wrecked on the Rattel Bank. The Princess Clémentine, which happened to pass near, at once sent a message to Ostend, and, before leaving, was able to tell the shipwrecked sailors that assistance was on the way. The men were all saved. On another day, coming within sighting distance of the Ruytingen Lightship, situated about 28 kilometres from Dunkirk, the captain of the Princess Clémentine observed that he was being signaled. It appears that the lighting apparatus of the Ruytingen had gone out of order. The captain of the mail packet immediately despatched a message which was received by the installation at La Panne, and repeated to the lighthouse department at Dunkirk. A crew immediately set out for the lightship and effected the necessary repairs, and the great inconvenience and danger of the lightship not being able to have the lights in order was averted.

Another instance of the usefulness of the wireless telegraphy in an emergency was furnished when the Princess Clémentine herself went ashore on the Belgian coast during a fog. Within a few minutes of the accident news of it was telegraphed from the stranded ship to Ostend, with the result that a tug was at once despatched to her assistance, and she got off at the next high tide. So successful has the installation of wireless telegraphy been on the mail steamer Princess Clémentine, between Dover and Ostend, that similar apparatus is to be fitted on the other vessels of the same fleet.

The system has been in use, furthermore, since March 1 last, for ordinary commercial telegraphy between the Sandwich Islands, where a regular charge is made for the same. An installation has also been successfully carried out by my assistants for the French Government, between Antibes, in France, and Corsica, a distance of 200 kilometres.

As has already been published in the daily papers, much use has been made of my system in the navy during the voyage of the Duke and Duchess of Cornwall and York to Australia.

I have tried lately to ascertain how near a tuned transmitter, which is radiating waves of a certain frequency, must be to a receiver tuned to a different frequency, in order that the said receiver shall be affected. I find that if we are working with oscillations which differ very considerably in period, a transmitter capable of sending signals 50 kilometres to a tuned receiver will not affect a non-tuned one at 50 metres. If the periods of oscillation of the two tunes are more similar to each other, then the non-tuned receiver may be affected even at several kilometres.

Considerable use is still made of the non-tuned system at my experimental stations, in order to be able to communicate with ships fitted with what I call the old system, and also in order to be able to communicate with the naval station at Portsmouth.

Before concluding, I wish to say a few words on a method proposed by Professor Slaby, and with which I have also carried out some experiments. As transmitter, Slaby uses an arrangement as shown in Fig. 13, which consists of a vertical conductor, in which is interposed a condenser, K, and a spark-gap, B. The top of the wire is not free, but is connected to earth through an inductance, C D, and a wire, E.

At the receiving station the arrangement shown in Fig. 17 is employed. It consists in a vertical conductor, D C, connected to earth at C, which should be the nodal point of the waves induced in the wire, D C, where there is joined another wire, termed an extension wire, of equal length.

In this case Slaby places an apparatus which he calls a "multiplicator," connected to the coherer between the end of the extension wire and the earth, or by another arrangement (Fig. 17); he uses a loop wire, F G H D C E, the multiplicator being placed between E and F in series with the extension wire J. By means of this arrangement, Slaby, on December 22 of last year, showed the reception of two different messages sent from two transmitting stations situated at unequal distances from the receiving station to be possible, one station being at four kilometres and the other at 14; thus obtaining a result which may be considered similar to that obtained by me some months previously over larger distances (see Professor Fleming's letter in *The Times* of October 4, 1900). The information given in Slaby's paper, as published in the *Elektrotechnische Zeitschrift,* is exceedingly incomplete.

We are not told what was the amount of energy used for the transmission nor the height of the vertical conductor at the receiving station or at the transmitting station at the Oberspree Kablewerk. We are only told that the transmission wire was suspended between the chimney shafts. Very little information is given as to the appliance which Dr. Slaby calls a multiplicator. G. Kapp, who is probably acquainted with the details of Slaby's work, commenting on this paper of his, calls the instrument in question "an especially wound induction coil ('induction-spule'), the function of which is to increase the electro-motive force of the oscillations at the end of the coherer." Upon reading this for the first time, I assume that the multiplicator was an oscillation transformer performing the function of those described in my patent, dated June 1, 1898, and also described in my Royal Institution lecture of February 2, 1900. As I subsequently, however, discovered, Professor Slaby, referring to the multiplicator, states: "This apparatus in its most simple form consists of a wire coil of a determined shape and form of winding, which depends upon the length of the wave. . . . I might call this apparatus, unknown

to my knowledge up to the present, a multiplicator. It is not to be confounded with a transformer, as it has no secondary winding."

This statement appears to me very ambiguous, as I have always understood that what we call transformers need not have a distinct secondary winding. An appliance called an auto-transformer was used by the Westinghouse company for regulating the electro-motive force supplied to house lighting installations, which consisted in a single winding, a certain number of turns acting inductively on the adjacent ones. (See "The Alternate-Current Transformer," by J. A. Fleming, vol. 2, pp. 187, 188.)

One of the first transformers ever made is shown in the work above referred to, vol. 2, pp. 6 and 7. At page 6 we read: "Page really made the first experiment in auto-induction and showed that different parts of the same conductor might act as primary and secondary circuits to each other, if in contiguity."

I installed the apparatus described by Slaby, at Niton, Isle of Wight, and at Poole, using wires 35 metres high, but with the receiving wire earthed at C (Fig. 17) of the loop I could receive nothing, although I tried various frequencies of oscillation. It is, however, probable that I might have received, had I been working over much shorter distances than 50 kilometres, as Slaby did in his demonstration, or had I used a greater height of wire.

By using, however, my method of connection—*i. e.*, introducing between the vertical wire and earth an oscillation transformer, having its circuits tuned to the frequency given by an ordinary vertical radiating conductor of length equal to the Slaby wire, A C—I succeeded by means of extremely sensitive coherers in obtaining communication. I then tried the following experiment: I took down the earth wire, E D, and the inductance, D C, and used only the conductor, A C, insulated, with the condenser in circuit for transmitting. An enormous strengthening of the signals at the receiver was immediately obtained, which obviously means a greater ease of working, and the possibility of obtaining signals over greater distances. The reasons which demonstrate that a closed circuit, such as is employed by Slaby, must be a poor radiator, are obvious to those who have studied and read the classical works published since the time of Hertz's experiments.

Dr. Slaby, however, states that the inductance at the top of his loop confines the oscillations to the vertical part, A C. If this be the case the frequency of these local oscillations can not be equal to that of the whole circuit, A C D E, which it has been stated was so easy to calculate, if the translations of Slaby's paper I am relying on are correct.

I believe that notwithstanding the inductance, C D, a considerable amount of energy must pass to earth through the earthed wire, which acts as a leak uselessly dissipating energy which should be radiated into space in the form of ether waves.

If these conclusions are correct, I am not at all clear as to what necessity there is for employing the earthed conductor, E D, and the inductance.

It is not necessary for obtaining syntonic effects from transmitting stations placed at unequal distances from the receiver, as this can be obtained when using the primitive form of transmitter shown in Fig. 1, and Slaby has not yet described how to obtain different messages from transmitters situated at equal distances from the receivers, which is much more difficult in my experience, nor does it appear possible with the method he describes to transmit various messages at the same time from one sending wire, as can be done with the system I have just explained.

The distance obtained with the closed transmitting arrangement must be comparatively small.

As I have already stated, communication over a distance of 300 kilometres is now being maintained with my system, but I am not aware of anything approaching even 100 kilometres being achieved with the loop transmitter. It may be said that long distances of transmission are not necessarily an advantage, but I notice that the navy wants long-distance apparatus supplied to it.

I have also tried connections similar to Slaby's extension wire in the receiver, but I find that the real sifting out of waves is done in the oscillation transformer, although sometimes it may be desirable to increase the period of oscillation of the aerial conductor by adding inductance to it, or at other times to decrease its period by placing a suitable condenser in series with it.

I trust that it will not be thought that I wish in any way to minimize the importance of Slaby's work. I only wish to get at the facts and to draw a discussion on a very interesting subject.

Time does not permit me to refer to a great number of experiments upon which I am now engaged, or which have been carried out by others, but I hope on a future occasion to describe better results.

I have come to the conclusion that the days of the non-tuned system are numbered. The ether about the English Channel has become, in consequence of great wireless activity, exceedingly lively, and a non-tuned receiver keeps picking up messages or parts of messages from various sources which very often render unreadable the message one is trying to receive. I am glad to say, however, that I am now prepared with syntonic apparatus suitable for commercial purposes.

And, as my final word on the general subject for the present, let me say that those who are responsible for the recent development of wireless telegraphy into a practical science can not fail to find great satisfaction in the reflection that, as already life has been saved that without this discovery would have been lost, so, in the future, apart from its manifold commercial possibilities, valuable as these are, humanity is likely to have before very long to recognize in telegraphy through space without connecting wires the most potent safeguard that has yet been devised to reduce the peril of the world's seagoing population.

[The discussion of Mr. Marconi's important paper will be given in the ELECTRICAL REVIEW's next issue.]

Electrical Death.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

I personally had an experience, while employed by a company manufacturing alternating-current apparatus, of accidentally taking 2,300 volts, at 133 cycles, from my hands to my feet—one line held in my hands and the other on an iron floor on which I stood. The time I held the cable was only a few seconds, but I suffered no pain; I realized that death was near if the current was not taken off soon, and I don't doubt that death would have been instant if the frequency had been, say, from 25 to 60. I have my doubts if any person suffers while being electrocuted at Sing Sing prison, or in any other state prison, in the way I understand and as the electrodes are placed, or meets anything but instant death.

I experienced something at the time of the accident I met that very few have felt, and in such a manner that I can probably tell nearly the condition people are in while being electrocuted. Possibly I would have met death with the 133-cycle current if I had had anything but a strong heart.

W. H. M.

West Orange, N. J., June 7.

Decorative Electric Lighting at the Pan-American Exposition.

PROMINENT above all of the features of the Pan-American Exposition at Buffalo is the really wonderful and beautiful effect produced by the electric light decoration of the grounds and buildings. While it is true that this exposition enjoys a peculiar advantage in having Niagara power available in large quantities for lighting purposes, nevertheless the way that the lights have been arranged and the illuminations have been handled is worthy of much more than passing notice and reflects upon its designers the highest credit.

The effect that is most admired, and which lends a suggestion of mysterious quality to the almost magical effect of the lighting, is the slow growing of the lights from mere pin-points up to full glow. Witnessed from the great bridge which marks the entrance to the grounds the kindling glow is almost indescribably beautiful.

This effect of gradually bringing the lights up from darkness to full candle-power was first attempted at the Louisville, Ky., Exposition of 1883. On this occasion the field-magnets of the dynamos feeding the lighting circuits were built up slowly by cutting out resistance which had been inserted in them, this resulting in the gradual increase of the lights to full candle-power. The same effect was repeated the next year at Louisville and again was witnessed at New Orleans where the great music hall of the exposition was lighted with lamps arranged to be brought up in this manner. At the Chicago World's Fair of 1893 this effect was not reproduced, by reason of the fact that the decorative lighting circuits were for the most part driven from exhibit apparatus, each circuit being local to its own generating plant, and consequently the whole could not be operated together in any satisfactory way. The lights were simply switched on at the proper hour.

At the Omaha Exposition of 1898 Mr. Luther Stieringer in designing the decorative exterior lighting found an opportunity to undertake, free from interference, the entire lighting of the grand court with incandescent lamps. As it was possible in this case to derive the entire current for lighting from a single source, the lights were again built up by controlling the fields of the dynamos. The effect was reproduced the following year at the greater American exposition at Omaha.

The Pan-American Exposition presented an entirely different problem. The current to be used was alternating, of 25 cycles period, and came from a power-

ELECTRICAL ILLUMINATION OF THE TRIUMPHAL BRIDGE AT THE PAN-AMERICAN EXPOSITION.

house 20 miles away. It reached the exposition grounds at a pressure of 11,000 volts and underwent a transformation to intermediate voltages of 1,800 volts or thereabouts and a second transformation for feeding the lamp circuits proper. The great desirability of creating the effect of growing light was strongly evident and was early brought to the attention of those in interest.

The only solution considered at first was the use of frequency changers, consisting of motors coupled with generators, and the controlling of the fields of the generating part of these units. On account of various considerations, chief of which was the cost involved, this method was prohibitive. As a final solution it was suggested that a great rheostat might be built, like those commonly in use in the testing department of the General Electric Company's works at Schenectady, and Mr. W. L. R. Emmett was applied to for such a device, since his experience in that direction has been so large as to warrant the assumption that he could provide such an apparatus. The work was undertaken, and while the result was for some time in doubt by some persons, yet Mr. Emmett succeeded in producing a water rheostat that acts as a mammoth dimmer and controls the entire energy supplied from Niagara Falls to the exposition. The beauty of the effect must be seen to be appreciated.

It is interesting to note that, before the full load of the exposition lighting was ready for connection, the effect of gradual increase in brilliance and gradual dimming to extinction was attained by using only one machine at Niagara Falls as a source of energy, working this over an independent circuit to the exposition grounds and building up its fields in the manner described before. As soon as the load became large, however, for obvious reasons, this machine was put in multiple with the others at the power plant at Niagara and the pressure supplied to the transformer station at the exposition was necessarily constant. The rheostat was then for the first time put in operation.

This rheostat is located on the western side of the grounds in a section of the Midway. The whole of the apparatus is located in a house set upon poles about 16 feet high and containing the very simple appliances necessary to produce the wonderful effect. There is one tank of water for each phase of the circuit, each tank being ten feet long by three feet wide and three feet deep. These stand on feet consisting of the same porcelain insulators that are used on the transmission line. Into these tanks three cast-iron plates are lowered to vary the resistance of the circuit. The plates are about eight feet long by three-quarters of an inch thick, and so pivoted that they come down gradually into the water and finally strike a clip, causing a short-circuit of the rheostat. All three of the plates are lowered together by means of a small electric motor geared to their controlling pulleys, and this is generally operated by a man in the rheostat house, although, if desired, it may be worked from a distance. For lighting, 45 seconds is usually required, while in shutting down it is customary to make the process last for 75 seconds.

It was found entirely impossible to attempt breaking the current finally at the rheostat, or by pulling the cast-iron plate out of the water, as the arc thus formed would be very destructive. The circuit is broken by the main oil switch on the switchboard in the Electricity Building.

The credit for bringing about this beautiful effect on a scale of hitherto unapproached magnitude is largely due to Mr. Henry Rustin, the chief of the Mechanical and Electrical Bureau of the exposition, and Mr. Luther Stieringer, the consulting electrical engineer, whose persistence in the face of great difficulties finally achieved the apparently impossible.

The Kitson Light.

From a report by Professor V. B. Lewes and Mr. Boverton Redwood, it would seem that the arc lamp and the incandescent gas light are about to meet with a powerful competitor in the Kitson incandescent petroleum light, says *Engineering*. In this light ordinary kerosene is gasified under a high pressure, and used to heat a mantle of the ordinary Welsbach type. The report states that the light generated averages 1,000 candles over extended periods of time, and the loss of luminosity, due to deterioration of the mantles, is not greater than in the case of ordinary incandescent gas lights. The candle-power of the light varies directly as the pressure in the oil reservoir, and this is accordingly made of sufficient size to prevent any marked reduction of pressure in 24 hours. The oil reservoir is a strong cylinder fitted with a pressure gauge, and in this the oil is stored at a pressure of 35 pounds per square inch or more. The oil is gasified by the waste heat from the burners, the temperature of the vaporizer coils being so adjusted that no decomposition of the oil occurs. At starting, these coils have to be heated by a separate source of heat, which may be afforded by methylated spirit, as in the well-known Primus type of lamp, or by a vapor lamp using some of the lighter petroleums as fuel. The report states that the amount of oil needed to maintain a light of 1,000 candles is only one-tenth gallon per hour.

Views, News and Interviews

The recent Independent telephone convention furnished some rather amusing situations. On the morning of the second day's session a smooth and plausible individual who was agent for one of the transportation companies in Buffalo obtained permission to speak his little piece before the convention and, by describing the beauties and luxurious accommodations of the route he represented, lured the convention into taking the trip in a body. As the morning session was unduly protracted and it was necessary to catch a boat at 2 P. M., the large majority of the 250 persons who went on the excursion started without lunch, expecting to enjoy the sumptuous repast promised by the agent on board the boat. There was nothing whatever to eat on the boat, except what had been carried by a few far-seeing and provident persons. After about an hour's steam, the party was landed upon the inhospitable shores of Canada at a place which consisted of a sand-bar and a trolley track, with one building having seats running around it, the whole having been freshly painted that morning. There were no trolley cars waiting to receive the party. After about a half-hour's grilling in the hot sun one trolley car came along. Into this, to the limit of suffocation, piled some of the more fortunate of the delegates. Journeying along as far as Queenston, Ont., in it they were again turned loose, this time upon a grassy spot, well shaded, where a wait of an hour and twenty-five minutes was enjoyed before another car came along to take them back to the United States. It was at this point that the fun began. According to the usual custom of crowds of this character, after the first realization that they had been "done," they proceeded to make the best of it. Several games were started and the president and several other officers of the Independent Telephone Association, among them Messrs. H. D. Critchfield and E. B. Fisher, indulged in a long and hotly contested game of mumble-peg. The providential appearance of a trolley car saved one member of the party from the customary penalty attached to this game —pulling a wooden peg out of the ground with his teeth.

Mr. T. A. Edison has brought suit in Wilmington, Del., for an injunction restraining the Edison Chemical Company from using his name, he having no connection with that concern. It manufactures ink tablets, by implication supposedly of Edison's invention.

A NEW PHONOGRAPHIC PRINCIPLE.*

BY W. NERNST AND R. VON LIEBEN.

As is well known, the Poulsen phonograph has, in recent times, excited well-deserved attention, not only because of its absolutely pure reproduction of human speech, but, above all, because of the originality of the idea on which the apparatus is based. Instead of employing, as Edison did, soft masses to fix the tones by means of mechanical deformations produced by the sound waves, Poulsen uses the magnetic effect of the microphone current upon a magnetically deformable substance—steel. It is evident that one can, in general, employ on the phonographic principle any process which will produce a lasting change proportional to the corresponding action of the voice. One might conceive an electrification of insulators (which would be, so to speak, an electrostatic analogue to the Poulsen electromagnetic apparatus), a photochemical process, etc. The electrochemist will, in the first instance, however, bethink himself of the permanent change which an electric current produces in an electrode, *i. e.*, galvanic polarization. The following experiment may therefore be made (Fig. 1): An endless belt of platinum runs over two rollers and is continuously moved by a motor and polarized by a microphone current. As a necessary condition is that the variable polarizations produced by the current variations must be separate from one another in position, the platinum belt must move with considerable speed on the one hand, but on the other hand, the contact surface between the belt and the electrolyte must be as small as possible. The latter condition is sufficiently fulfilled if one employs as an electrolyte a wooden wedge which is saturated with a conducting liquid held in a glass trough provided with an electrode. In the figure, M is a microphone which is connected in the primary circuit of a transformer, in which circuit are also five accumulator cells, S is the secondary coil of the transformer. For receiving the record the throw-over switch, W, connects the apparatus with S, and for reproduction connects it to the telephone, T. B is a battery of variable pressure which can, if required, be connected in the circuit. The experiment succeeded completely. One heard a more or less clear reproduction which could be repeated several times before the volume of sound had noticeably diminished.** However, the quite unexpected result was easily remarked that for reproduction it is necessary to have a current in the telephone circuit, and that, at least, within certain limits, reproduction is louder the stronger the current is. To regulate this current a variable electro-motive force can be connected into the secondary circuit. Evidently this phenomenon is not compatible with the idea that the currents reproducing the sounds in the telephone are nothing but discharge currents from a polarized electrode. Such a discharge would naturally have to occur when no

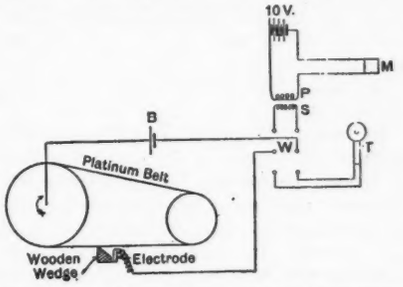


FIG. 1.—A NEW PHONOGRAPHIC PRINCIPLE.

permanent current was flowing, and the superposed permanent current would have no influence on it. The assumption that the variation in resistance or contact resistances of the polarized platinum belt caused the effect would certainly agree with the above-described behavior. For these would naturally require a current to make the variations in resistance active,

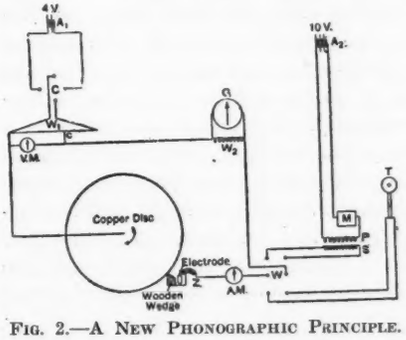


FIG. 2.—A NEW PHONOGRAPHIC PRINCIPLE.

and the volume of sound would necessarily, as had been observed, increase with the value of the constant current.

The following observations, however, make this explanation questionable. It it difficult to assume that hydrogen or oxygen polarization on platinum would cause noticeable variations in resistance. Besides, a very strong action is also noticed in employing a solution of silver-potassium cyanide and a moving strip of silver (see the following communication), in which any variation in resistance is certainly not to be expected. We would put forward the following explanation as most probable: Variations of the microphone currents cause a superficial disintegration of the metal electrode passing through the electrolyte. According to the amount of this disintegration, which would naturally be accompanied by a change in the polarization capacity, variations in the constant current would occur on reproduction, which would be reproduced as sounds in the telephone. Although, as already remarked in some cases a really clear and sufficiently loud reproduction of spoken words occurs, we believe, nevertheless, that the above-described arrangement would not afford any practical utility on account of its frequently uncertain behavior, and also for other reasons.

ADDITIONAL NOTES BY HERR ROBERT VON LIEBEN.

As a continuation of the experiments contained in the above article I have tested other metals than the above-mentioned platinum in their applications to an electrochemical phonograph. The frequent tearing of the platinum belt, in consequence of the continual bending, disturbed the observations, as did also the joint in the belt. So it was necessary to try another arrangement. The following showed itself suitable:

A copper disk, about two millimetres thick and 450 millimetres diameter, screwed between two strong cast-iron plates, rotates on a pivot bearing. Parallel to the cast-iron plates a second driving-disk, also of cast-iron, is keyed. This is driven by an india-rubber friction pulley at the end of the shaft of a small electromotor. By moving the electromotor on slide-bars at right angles to the axis of the copper disk, the friction pulley can be made to drive the cast-iron disk either near its centre or its periphery, so that different speeds can be given to the copper disk. The edge of the copper disk is carefully turned up, and current may be led to it directly through the pivot bearing. The other electrode is in a small glass trough, measuring about 20 by 5 by 10 millimetres, in which also is the wooden wedge (beech or cane) which is saturated with the electrolyte. It was found advantageous to connect the trough with a weak spring, so that the point of the wooden wedge is gently pressed against the periphery of the copper disk. The latter is about three millimetres wide, and the width of the contact of the wedge about one-half millimetre. The smallest speed which could be employed for clear reproduction was about

*From the *Zeitschrift für Elektrochemie*, translation by the *Electrician*.

**The above-described experiment had been already made by me in June of last year; without knowing this, Herr von Lieben suggested to me soon afterwards the making of a phonograph based on the variations in resistance which could be produced by the electrolytic deposit of films of oxide or the like on metal electrodes. Thereupon we continued the investigation together.—W. NERNST.

60 revolutions per minute, and the purity of the tone increases as the speed increases. There was easily room for one or two words on the periphery of the disk. In order to prevent disturbing noises it was necessary to insert a pad of blotting paper or similar material, soaked in the electrolyte, which pressed gently against the periphery of the disk. This prevented the crystallization of the film of electrolyte, as it passed through the air, without moistening the periphery too much.

Fig. 2 shows diagrammatically the connections employed, these being almost exactly as in the previous experiment. A resistance W_1 is added, however, with a sliding contact, *c*, which enables the electro-motive force of the trough to be compensated so that the null instrument, G, indicates no current. In making the record the current takes the following path: From the accumulator battery, A_1, it flows to the switch, C, a part going through the resistance, W_1, and the voltmeter, VM, and part through the periphery of the copper disk, and thence through the saturated wooden wedge to the electrode. From here, through the ammeter, AM, the mercury contacts, W, then through the secondary coil, S, again through the contacts, W, to the null instrument, G, the sliding contact, *c*, the switch, C, and back to the battery. If the sound is to be reproduced, the connection to the mercury contacts is changed so that the current flows through the telephone, T. While recording, the battery A_2 sends current through the microphone, M, and the primary coil, P. Induction currents are therefore produced in S, which are superposed on the constant current of the battery, A, and vary its value. The ratio of transformation, P to S, is not unimportant. As the result of trials the best was found to be 1.80. Many experiments were not made with regard to this, but there must be a certain best ratio. The resistance of the microphone and telephone was taken as small as possible. It was found to be a decided disadvantage to connect the microphone directly into the circuit of the battery, A, as, on account of the disturbing noises which take place with a high current density at the contact surface of the wooden wedge (due to interruptions through bubbles of gas, etc.), this would necessitate too small a value for the current in the microphone for it to work well.

Experiments lead to the conclusion that an explanation of the phenomena by pure polarization effects is untenable, and that the effects are also not in all cases consistent with the assumption of charges in the contact resistance. Professor Nernst has kindly called my attention to a third possibility to which I will allude briefly; it is the variation in friction at polarized electrodes, noted by Edison and others. It would be conceivable that in our case also the friction between the copper periphery and the electrodes, varied in amount by the polarization, could give rise to a corresponding variation of the section of the drop forming contact between the wedge and the periphery by which the reproduction might be explained as well. This is merely put forward as a surmise, however, as the variation in friction has hitherto only been observed at electrodes polarized by gases, while many of the above experiments indicate no evolution of gas at all. All things considered, therefore, the explanation already put forward as possible in the first note seems the most likely one—namely, the change in the polarization capacity. Of course, the possibility is by no means excluded that several effects may be superposed in these experiments.

In conclusion, the most convenient method of obliterating the sound waves recorded on the periphery may be indicated. For this purpose a pad soaked in acid and pressed against the periphery was used with success. It was found better to connect this pad with one pole by means of an additional electrode, by which means a wide electrolyte deposit is obtained, analogous to a coarse brush, which covers up the fine variations. However, the most certain and quickest method is to obliterate with very fine emery paper.

The Lindsay Monument.

The committee entrusted with the selection of the monument which is to be erected to mark the grave of James Bowman Lindsay, whose fame as a pioneer in electrical science is generally acknowledged among electricians, have decided upon the design to be adopted, says a British contemporary. The monument consists of a lofty column of gray granite, mounted on a graded base, with simple classical ornamentation. The total height will be nineteen feet three inches and the width four feet. Surmounting the pillar is a bronze hand holding a thunderbolt, typifying man controlling electric energy. The front of the monument bears an inscription testifying to Lindsay's services as "a pioneer in electrical science." The inscription also embodies the following passage: "He devised an electric telegraph in 1832, suggested welding by electricity, produced a continuous electric light in 1835, proposed a submarine transatlantic telegraph in 1843, and accomplished wireless telegraphy through water in 1853." In accordance with a suggestion thrown out by Sir John Leng some time ago, passages from Bowman Lindsay's own writings are engraved on both the south and north side of the monument. It is thought that the appearance of the monument will be much improved by placing a granite curb around the grave, and subscriptions for that purpose and for the completion of the work will be received by Mr. A. H. Millar, *Dundee Advertiser* office, Dundee, Scotland.

Electric Railways in Italy.

There are now in Italy 3,179 kilometres of street tramways worked by mechanical power, 263 kilometres of these by electricity, and the remainder by steam power. They are owned by 64 companies and private concerns. The town of Milan owns only five and one-half kilometres, while the two largest companies control 261 and 205 kilometres, respectively.

United Electrical Contractors' Association.

Secretary W. H. Morton, Utica, N. Y., states that the national meeting of Electrical Contractors will be held in Buffalo, July 17. From the large number of replies he has received, it is evident that the meeting will be quite largely attended. Full information concerning the object of the convention can be obtained from the secretary. All persons who contemplate attending should write to Mr. H. I. Sackett, president of the Buffalo Contractors' Association, Builders Exchange, Buffalo, N. Y., who will arrange hotel accommodations.

Pacific Coast Electric Transmission Association.

The Pacific Coast Electric Transmission Association held its annual convention at San José, Cal., June 18 and 19. The attendance of electric light, electric railway and power-transmission men from all parts of the Pacific coast was large, and the meetings were highly interesting.

A special feature of the convention was experiments with the long-distance lines of the Standard Electric Company, whose circuits extend to San José from the North Yuba River in the Sierra Nevadas, more than 184 miles away. For demonstrations and test purposes current at 60,000 volts, three-phase, was used. Normally these lines work at 40,000 volts.

Water-Power Developments in France.

Extensive plants are to be erected within the next three years between Pyrimont and the Swiss frontier for the development of power from the River Rhone. The first of these projects is that of Malpertuis, two and one-half miles below Bellegarde, where the river falls 30 to 35 feet, with perpendicular banks only 160 feet apart. By building a tunnel one-half mile long, a total fall of 51 to 55 feet can be secured, equivalent to 25,000 horse-power, at low water. Near Bellegarde another tunnel would secure a fall of 80 to 85 feet, developing 30,000 horse-power. And about eight miles from the Swiss frontier is a narrow gorge only 80 feet wide, and a dam built here would give a fall of 65 feet, or 30,000 horse-power, at low water.

THE METRIC SYSTEM.

BY GEORGE H. DRAPER.

The matter of United States weights and measures is now being actively agitated and it is the intention of the friends of the metric system to urge Congress at the coming session to pass a law establishing this system.

Progress and improvement are the watchwords of the Twentieth Century, and the pushing business people of this country can no longer stand by and permit old modes to prevail. In every phase of activity there has been a rejection of the old and a substitution of the new. The United States is far behind in the matter of weights and measures.

It is learned that the new National Bureau of Standards, recently established by Congress, though it does not go into effect until July 1, is already in receipt of many inquiries and communications from manufacturers, merchants and others in regard to the essential features of the metric system and the facilities of the bureau for providing them with metric standards of all kinds.

It has been felt by the advocates and supporters of these weights and measures that such an institution as the Bureau of Standards would be a necessity in the event of the adoption of the system, and now that the institution is an assured fact, they are highly elated and can see nothing serious ahead to prevent the next Congress from passing the metric bill. Indeed, those interested are now arraying their forces for an effective summer campaign.

For many years, indeed, since 1821, the adoption of this system by Congress has been urged and no later than the last days of the last Congress the Committee on Coinage, Weights and Measures of the House of Representatives, through its chairman, Mr. J. H. Southard, reported favorably upon a bill having this object in view, but too late, however, in the session to secure action by the House, and at the coming session this winter the measure is to be pushed with great vigor.

It has been evident for some time that sooner or later this country would be compelled to adopt the metric system, if for nothing else than our enormously increased export trade. In fact this system is used at present to a very much greater extent than is generally supposed. Practically all of the invoices of textiles and many other importations are expressed in metric terms and have to be translated at our custom houses. Importers must also calculate cost in metres and fix the selling price in yards. This shows two things: First, the ease with which the metric system can be used, and, second, the great saving of labor that would be effected. An enormous amount of time, labor and expense would be done away with in the bookkeeping departments alone of our large department stores and factories. Our manufacturers would be enabled to entirely do away with the cumbersome and intricate method of figuring as used at present, involving, as it does, much time and labor—far greater than would be the case were calculations made in simple "tens" and "tenths" with hardly any mental effort.

Those who have used the metric system find that many of its supposed disadvantages disappear upon use. They early learn to think, as it were, in the metric system, and instead of asking for so many pounds — an arbitrary mass without legal standing in the United States—they would substitute kilogrammes. It is a well-known fact that a traveler abroad often visits five or six different countries during the journey and he unconsciously adopts himself to the new systems of money and becomes familiar with the metric system of weights and measures in a remarkably short space of time. This is all due to the fact that actual business transactions are carried on in this system. But a foreigner traveling in the United States who is not familiar with our customary weights and measures finds it almost impossible to wade through the intricate mazes of three feet one yard, 144 square inches one square foot, or five and one-half yards one rod. Yet our decimal system of money—cents, dimes and dollars—is immediately acquired by the most ignorant immigrant landing on our shores. During the short interval of becoming familiar with the metric system, and, to a certain extent, translating from one system to another, there are a number of convenient equivalents which are sufficient for purposes of translation. For instance, the litre is midway between the dry and liquid quart, and the liquid quart is so slightly larger than the litre as to be sufficiently accurate to prevent making any serious error for every-day use. This is also true with the length measure; 10 metres equal 11 yards, 3 decimetres 1 foot, 25 millimetres 1 inch and the ½ kilogramme 1 pound. All are sufficiently near to prevent serious error. Thousands of people to-day in purchasing ale or beer by the mug do not know that they are buying a quantity measured by the metric system, but this is true, and if they will notice near the top of each mug there is a mark ⅓ L or ¼ L as the case might be, indicating that the mug holds one-third or one-quarter litre, instead of one-third or one-quarter quart. These mugs are imported from Germany and that country uses entirely the metric system.

It has been claimed, and somewhat justly, that manufacturers of machinery who have standard drawings and tools for certain sizes and styles of machines would be subjected to very great inconvenience and financial loss on account of a change, but if any ordinary drawing, the dimensions of which are expressed in inches and the nearest sixty-fourth of an inch is converted into the metric system and these same dimensions expressed in centimetres and the nearest hundredth part of a centimetre, the dimensions are expressed to the same degree of accuracy, and for practice very much more convenient for purposes of calculation. The ease with which the system can be adopted is shown by the experience in Germany, where catalogues in both English and metric terms were employed before the metric system was adopted by that country, and the mechanics worked on the basis of both systems without embarrassment. There is no first-class shop in America that will not undertake to build machinery according to metric measurements, and many of them are at the present time compelled to build stock forms of machinery in measurements of this system in order to be able to compete for trade in foreign countries where the specifications are given in round metric terms.

It is a well-known fact that all scientific workers must and do use the metric system. In many of the applied sciences, as, for example, electricity, the calculations must all be made in this system and afterwards converted into the common system, an unnecessary labor, together with the loss of much valuable time and accuracy. To-day it is difficult to get any electric machinery that is not constructed on the metric basis. The commonest term of that science is a metric term—kilowatt.

Again, the public schools throughout the country are thoroughly equipped in laboratories for teaching experimental sciences and in all of these the metric system is in more common use than the English, and, hence, the alleged inconvenience incurred by the adoption of these weights and measures is greatly overestimated, and the arguments against them are offered by people who are not familiar with their use and the many advantages to be gained thereby.

Freight can be carried on trolley cars within the city limits of Detroit.

INDEPENDENT TELEPHONE DEVELOPMENT EAST OF THE ALLEGHENIES.*

BY C. W. KLINE.

About five years ago the question of better and cheaper telephone facilities came under discussion in what is known as the East. The result of this discussion was that here and there small plants were installed and in a small way local service was instituted. The first plants were crude; the switchboards somewhat inferior; the material, I am sorry to say, not of the best. But at any rate, in even this inferior construction and poor equipment, it was found that as good, if not better, service was given than had ever been received from the Bell companies, and even under adverse circumstances the plants held their own, and, in nearly every instance, doubled or trebled the number of telephones owned by their rivals. The people—the business world—were with the independent companies. The Bell monopoly had disregarded their needs, charged exhorbitant prices and inferior service, cared nothing for their necessities, so they were ready to welcome competition, which they firmly believed could only result in benefiting them. So, from the very start, the cause of independent telephony was made the cause of the people, and results to-day amply demonstrate that the people were right, and human progress received another strong push upward and onward. While our infant plants were struggling for existence, were trying to bring order out of chaos and carry out promises to the public, they were encouraged and sustained in their efforts by news that floated across the Alleghenies from the giant West where earlier efforts had been instituted along long-distance independent telephone lines.

Soon larger plants were installed and the question of local toll lines was being discussed, and the question of securing franchises for the large cities was undertaken. This, in many instances, was found to be an extremely difficult task, a rival firmly intrenched, with unlimited financial backing, threw every obstacle in our way, but we worked steadily on (in some instances it has taken three years to get a franchise), but with a persistence and energy that would not allow defeat and failure, the fight was kept up. To-day the independents have a franchise in every large city, except Washington, east of the Alleghenies, and not only in the large cities, but in the boroughs, towns, hamlets and villages. At the cross-roads and leading farms, the tinkle of the call of the telephone bell is heard everywhere, bringing our East so close together that we are all neighbors, and already the plans are prepared and the routes surveyed across the Alleghenies that will link the East with the West. We hope by the time of the meeting of the next annual convention that Boston, New York, Philadelphia and Baltimore, and all surrounding territory will have toll lines for Pittsburgh and the West. While much has been accomplished in a very short time, much still remains to be done. Some of our principal cities are fully built and some are building—all are in motion. Under the splendid management of S. E. Wayland, superb plants have been installed in Scranton and Wilkesbarre, Pa., covering the Lackawanna and Wyoming Valley, with an easy possibility of 30,000 telephones in sight and 7,000 telephones now at work. Allentown, the centre of the Lehigh Telephone's system, with a possibility of 5,000 telephones, with about 1,800 installed, has a splendid system, well built and equipped. Then Reading, which is being built; Easton, working the lower Lehigh; the Overland, of Lehighton, reaching out its tentacles for everything in sight; the Anthracite, of Hazleton, embracing everything in lower Luzerne, upper Carbon, the northern Schuylkill counties; the Standard, of Bucks and Montgomery, now being rebuilt by G. S. W. Brubaker, covering all that section; the United Telephone Companies, embracing Norristown, West Chester, Lancaster, Lebanon, all of the Schuylkill, Northumberland, Montour and Columbia counties, and the north and west branches of the Susquehanna. Harrisburg is building, and Columbia, York, connected *via* Carlisle with Chambersburg, extending its lines in every direction in York and Lancaster counties and connected west of the Alleghenies. Philadelphia, under the able management of C. E. Wilson, general manager, is building one of the finest plants in the world.

All of New Jersey is awake, and up and doing. Every town in the state has an independent plant and they are giving good service. Fine plants have been installed at Rochester and Albany, which, we understand, are giving good service from the Hudson to the Mohawk Valley. The United Telephone Company of Pennsylvania covers the southern portion of New York state. The Maryland Telephone and Telegraph Company has a splendid plant at Baltimore, and the chain of independent companies stretches south along the Atlantic to the Gulf of Mexico. New York city, the metropolis of our land, has awakened from her lethargy and we are promised in the very near future a thorough and complete service. The New England States are falling in line and new plants are being constantly installed and some very good ones are already in operation. Boston, the hub of the universe, already has a finely installed system and is enlarging and perfecting it. So we say to our friends from the west of the Alleghenies that there is something doing in the independent telephone world east of the Alleghenies. While local plants have been successfully installed everywhere, everywhere where installed, except in the very few isolated instances, we are beating our older rival on the general average at least of three to one. I predict that in a very short time the territory east of the Alleghenies in Pennsylvania, my native state, will have more independent telephones than the Bell has in the same state, both east and west of the Alleghenies.

Now, while we are quite long on local plants we are yet a little short on toll lines, but we are trying to remedy this as fast as possible. Already the Inter-State Telephone and Telegraph Company has built lines in the east portion of the State of Pennsylvania, connecting up the entire eastern portion of the state with some 14,000 telephones, and has its terminal facing New York city at Trenton, and traveling along for 20 miles along the outer edge of Philadelphia, ready to jump in and connect with the first telephone installed there. They connect at Trenton with the lines of the State Telephone Company of New Jersey, that extends from Trenton to Jersey City. The Inter-State is ambitious and willing, ready to contract with and extend its lines to exchanges wherever needed, ready to cross the Alleghenies and make the chain complete that shall unite the West with the East, a grand telephonic brotherhood; but to do this successfully they must have the contract of all the independent companies along their pathway, as well as their encouragement and good will. The difficulty with the toll-line question, and the obstacle that has so far retarded its progress, is found in the inherent selfishness of humanity. We have too many companies ambitious to control the toll-line situation in the East, and it will take a little time to reconcile the differences and brush away the selfishness. All this we hope will take care of itself, because we believe that the fair-minded men can meet and agree on what is mine and thine in regard to the territory, and having so agreed they can pool their interests and bury their differences. We can not afford to fight among ourselves; we should try to remember that we have a resourceful business foe to oppose our every forward movement, and that we must stand together if we would deserve success.

*Extracts from a paper read before the Independent Telephone Association, Buffalo, N. Y., June 12, 1901.

RAPID TELEGRAPHY.*

BY WALTER P. PHILLIPS.

Up to the present time the automatic systems of telegraphy have belonged to that class of inventions in which more money was invested than has ever been taken out. There are those, of course, who will contend that the Wheatstone system has certain advantages, but when everything is summed up and a balance is struck, it is doubtful, as I view the matter, whether the introduction of that exquisite system has led to any real progress, as far as American telegraphy is concerned. A great deal has been claimed for this system in former years, in England, but recent reports show that it has lost ground there of late, while in the United States it cuts no important figure.

But whatever may be said against the Wheatstone system as a factor of value in these high-pressure days of instantaneous communication by telephone as well as by telegraph, the fact remains that it is far ahead of the many other automatic systems which have come into competition with it during the past 25 years. For that reason a brief description of it may be of interest.

The apparatus consists of a device called a perforator, a transmitter of most ingenious construction and an ink recorder. It is the mission of the perforator to make a series of dots in horizontal lines; of the transmitter to so distribute these dots into the line as to transform them into the dots and dashes comprising the telegraph alphabet; and of the inking mechanism to record them in a perfect manner, easily read and transcribed by the copyist at the receiving end of the line. The perforator consists of a set of five metal tubes, or punches, encased in a box within which is placed the mechanism by which the punches are operated. This perforator, like everything connected with the Wheatstone system, works perfectly. It has three keys which are depressed by the operator, who usually uses for this purpose rubber-tipped mallets—one in each hand. Sometimes perforators are supplied with a pneumatic arrangement rendering it unnecessary for the operator to more than touch the keys, which action opens a valve connected with air tubes and a piston, influenced by the air pressure, perforates the paper, instead of its being done by main strength as is the case when struck by the mallets.

Besides the two horizontal lines of dots which pass through the transforming mechanism by which they are changed to dots and dashes, there is a third line of fine dots—about 120 to the foot. These dots are placed between the other two and are used as a means of feeding the perforated tape through the transmitter, which not only handles it in a marvelous manner, but, by another ingenious contrivance, it sends "reversals," thus clearing the line of the static charge by a constant alternation of a current from the opposing poles of the battery. The Wheatstone recorder does not differ essentially from other inking mechanisms, but it is more elaborate, more accurate and in every way superior to everything in the same line that has ever been produced.

There may be countries where the telegraphing public is willing to have its messages delayed more or less, but in the United States people will not submit to it. In other countries the public may not know what goes on inside the sacred precincts of the telegraph operating rooms, but in this broad land of freedom, every man who does much telegraphing makes it his business to know all about the *modus operandi* of handling telegrams, and there are but very few of them to-day who do not know by its ear-marks whether a message reaches him by the Morse system or the Wheatstone. The first is well understood to be a method synonymous with the greatest possible alacrity and accuracy, while the latter is viewed askance and accused of being slow and incorrect. That there is an initial delay in perforating the slips is undeniable and many more errors are made in transcribing the tape by eye than in receiving the words by sound. All of this means a slow service, and is so well understood outside of the telegraph offices as well as inside of them, that cases are known where the falling off in the business of a company using the Wheatstone and the corresponding increase in the business of a company which operated the Morse system was so great that the former had to be permanently abandoned and the Morse system restored in order to regain the business which had gone over to the enemy.

Within very recent years the automatic telegraph in its original form has practically been discarded in favor of the primitive Morse which is by common consent the simplest and fastest system in the world. An attempt has been made to hasten this system by devices known as the Phillips-Morse automatic telegraph. This is a very unpretentious affair, using the Morse key for the preparation of an embossed tape which, without the slightest delay, is passed through a transmitter and over the line at a high rate of speed. The signals are received, at the remote station, on a recording apparatus which furnishes an embossed slip from which, when passed through a reproducer, the words as originally written by the sending operator are reproduced on a sounder and taken down with a pen or a typewriter by sound.

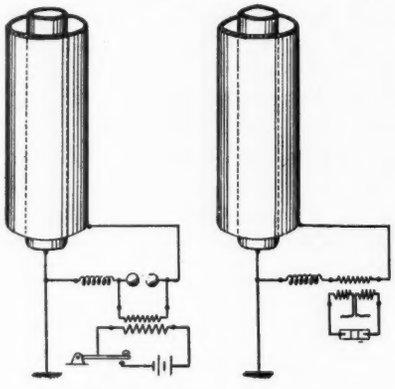
Mr. William B. Vansize, in a paper presented at the 150th meeting of the American Institute of Electrical Engineers, in January, 1900, said: "What telegraph officials really need is the simplicity of the Morse system combined with increased speed of transmission and economy of time between the transmitting customer and his addressed correspondent. Up to the present time nothing has surpassed the Morse for this purpose." And it is extremely doubtful if anything ever will. I believe, however, that the Phillips-Morse automatic telegraph can handle business as quickly as the Morse and that it will economize time on the wire. Not that it will handle millions of words in no time, like the systems that have been regularly brought forward and which promptly slipped from the experimental stage to the limbo of unutilized things, but it will achieve in its field the triumph of making two, if not three, blades of grass grow where only one grew before. And that is something, whereas the attempts of those who aimed to revolutionize the original methods have ended in absolutely nothing.

I have a very wholesome respect for the man who attempts something within the range of reason, and such a man is Donald Murray. He has entered a field that is almost alluring. It was not very long after the invention of the Morse telegraph that inventors began striving to achieve a telegraph that would deliver its messages in Roman characters. Royal E. House invented a printing telegraph away back in the fifties; Hughes invented one not so good, and, afterwards, George M. Phelps combined the two and produced a really beautiful machine which came to be known as the Phelps motor. Edison interested himself in the stock ticker, and, as far as short-distance printing telegraphs went, we had made progress 20 years ago. But what was needed was an automatic page printer that would work on long circuits and Mr. Murray seems to have come nearer to attaining this ideal than any one else. The Murray system involves the use of a perforated slip which is prepared on a machine which to all intents and purposes is a typewriter. This perforated slip is passed into the line at a moderately high rate of speed, and the pulsations caused by it produce a perforated slip at the remote station, which, when applied to a specially arranged typewriter, causes it to print in Roman letters that which was originally perforated at the sending station. There are some natural obstacles to be overcome before this system can be made a great and enduring success, but it is full of promise.

* Abstract of paper read before Railway Telegraph Superintendents, June 20, 1901.

Electrical Patents

Mr. G. Marconi has just obtained a patent on improved apparatus for wireless telegraphy, the principal feature of the improvement residing in means whereby the oscillations from a transmitting station may be localized as desired at any selected receiving station or stations. Novel mechanism is employed which greatly increases the efficiency of the system. Heretofore each station has been provided with a single aerial conductor for receiving or transmitting electrical oscillations. Mr. Marconi, however, has discovered that the communication of signals may be greatly facilitated by the employment at each station of two aerial conductors insulated from each other, and to which may be connected conductors leading directly or through a transformed circuit to a spark producer or other source of electrical oscillations, or to a coherer or like instrument influenced by such oscillations. Another discovery, covered by the patent, is that advantageous results are attained by the inclusion in the aerial circuits at both the transmitting and receiving stations of inductance, preferably employing (especially at the transmitting station) coils capable of wide variations of self-induction, whereby the resonance of the inductances at the transmitting and receiving stations can be harmonized, and the receiving apparatus caused readily to respond to the oscillations sent from the transmitting station. The aerial conductors at both stations may be disposed in any suitable way, care being taken, however, thoroughly to insulate them from each other. The preferred form shown by the inventor consists of an inner and an outer conductor. The inner conductor may be simple or compound, such as a metallic tube or a cable, and the second may be in the form of a tube surrounding the first-named, but thoroughly insulated therefrom. Instead, however, of this arrangement, the two conductors may be separated and arranged side by side. One of these double conductors is erected at the transmitting station and one or more at the receiving station. One of the conductors at the transmitting station is connected to one terminal of an induction coil, capable of giving electric sparks, and said terminal is also connected to the earth. The other terminal of the induction coil is connected to the other conductor. An inductance coil of variable inductance is connected with either one of the two conductors at each station, and when the conductors are of concentric form, the inner one is connected with the earth. At the receiving end an inductance coil is provided in series with either of the two conductors, and preferably with a similar earth connection to one of them, and a suitable form of sensitive tube or other Hertz wave-receiving device is located between the two conductors and the associate inductance coil. A telegraphic relay or other receiving device for recording the messages is likewise used. In employing the invention to localize the transmission of intelligence to one of several receiving stations, the following procedure is employed: At the transmitting end the inductance is one that may be varied over wide limits, while the receiving stations have coils of fixed inductance suitably selected. Therefore, if the inductance coil at the transmitting station has its inductance varied until the electrical system composed of the aerial conductors and the associate inductance coil is in resonance with that of one of the receiving systems, that one alone of all the receiving systems responds, provided that the distance between the transmitter and the receiver is not too small. In this manner, by systematic trials, each receiving instrument can be adjusted to respond to the transmitter when the inductance of that transmitter has a value corresponding to the particular instrument which is to be affected.



WIRELESS TELEGRAPHY.

The Rœntgen Society.

The second regular meeting of the Rœntgen Society of the United States will be held at Buffalo, N. Y., at the University of Buffalo, on September 10 and 11, 1901. The programme will be mailed about the middle of August. Those desiring information are requested to communicate with the secretary, Dr. J. Rudis-Jicinsky, Grand Rapids, Mich.

Germany and Holland are planning to lay a new cable to connect with the Dutch East Indies.

Another Gift to the American Institute of Electrical Engineers.

On June 14 Mr. Andrew Carnegie gave to the American Institute of Electrical Engineers the sum of $6,880.28, this being an exact duplicate of the total cost of the Latimer Clark library, which was lately presented to the Institute by Dr. S. S. Wheeler. The object of Mr. Carnegie's gift is to provide for the housing, cataloguing and completion of the Wheeler library.

Mr. Carnegie was approached on this subject some time ago and his interest in it greatly aroused. When he heard that Dr. Wheeler had bought the Clark library he was so much pleased to learn that the Institute possessed a member who would make such a gift, and one who would seize so quickly upon opportunity for aiding it, that he agreed at once to duplicate the amount. He said that he was greatly impressed by the good work that the Institute was doing and, in the presence of the committee that called upon him, he turned to his secretary and said that he wished him to see that in the various Carnegie industries only electrical engineers who were members of the Institute should be employed.

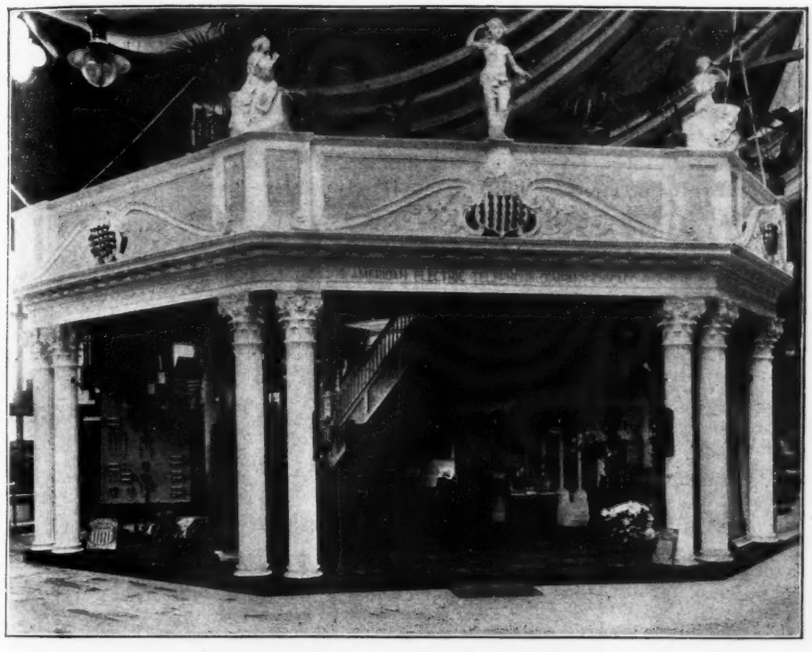
It is believed as sincerely as it is hoped that the effect of these two gifts will be greatly to extend the usefulness of the Institute and to awaken a further enthusiasm for its work. Its membership is growing at a very satisfactory rate and it bids fair, before long, to become the most important of the various engineering societies in this country.

Artificial Electric Fountains.

An Italian contemporary describes at some length the artificial electric fountains which M. G. Trouvé has lately erected. He uses glass beads, rice, small celluloid balls or other round or variously shaped small solid bodies, and a jet of air, blown by a centrifugal pump, as a means for keeping them in motion. When these objects are projected through a jet in the usual way by the stream of air and illuminated, magnificent effects, comparable to those of the electric fountain, may be produced. As the apparatus required is small and the material is used over and over again it is believed that some use will be found for these beautiful playthings in luxurious interiors and possibly for stage or other spectacular decorations. The color and illumination, as well as the shape and arrangement of jets, can, of course, be varied as easily with fountains of rice or glass beads as with fountains of water.

The American Electric Telephone Company's Pan-American Exhibit.

In the accompanying illustration is shown the handsome exhibit of the American Electric Telephone Company, Chicago, situated in the northeastern corner of the Electricity Building at the Pan-American Exposition. The structure is in the form of a half-octagon, giving excellent opportunity for displaying the exhibits contained in it from all positions of observation. The roof is supported by a colonnade of Corinthian columns, and upon it is a roof garden where hospitable provisions for the comfort and recreation of visitors are provided. The more prominent features of the exhibit are a standard power switchboard furnished with the company's central energy system and provided with ammeter, voltmeter, detector switch, over and underload switches, main line and battery switches and starting rheostats, the whole mounted on a slab of highly polished Tennessee marble. A dynamotor of 1.5 kilowatts capacity of the direct-coupled type, transforming from 500 volts and 3 amperes to 60 volts and 25 amperes, is also shown. Near the same piece of apparatus is situated a current interrupter giving an alternating current of 500 volts at 900 revolutions per minute.



THE EXHIBIT OF THE AMERICAN ELECTRIC TELEPHONE COMPANY AT THE PAN-AMERICAN EXPOSITION.

Among other interesting exhibits is a 100-line Bell style switchboard, finished in quarter-sawed hard oak, giving what is claimed to be the highest rapidity of operation and great perfection of service. A 300-line metallic cross-connecting board and a 100-line American express switchboard are interesting additions to the exhibit.

Included in the exhibit are five 100-line Burns combined heat coils, lightning arresters and terminal heads. This apparatus, on account of its exceeding compactness and simplicity, has attracted considerable attention at the exposition. The smaller parts and accessories going to make up the various lines of telephone manufactures of the company are shown in glass-covered cases. The new receivers, made without binding-posts, are shown here with all their parts.

A multiple switchboard made by the company is displayed in sections, showing its mechanical construction, and is designed for magneto call, common battery or central energy systems. Station instruments for these varieties of service are also exhibited in large number, no less than twenty-six distinct patterns being shown. The telephone set finished in antique oak, which is shown in this exhibit, is a remarkable exemplification of how successfully the decorative arts can be applied to the commonest objects of utility. Its design and construction were made under the supervision of Mr. S. J. Bear, general western agent of the American company, who is also in charge of the exhibit.

Some New Telephone Apparatus.

The illustrations herewith represent some varieties of telephone apparatus lately designed by the Haines & Noyes Company, Chicago, for a variety of different uses. In Fig. 1 is shown a wall set intended for interior use in hotels, apartment buildings, residences and private plants, which combines a number of interesting and novel features. In the illustration the instrument is shown furnished with a single-gong bell, but, if desired, a buzzer can be used in place of this. The receiver is of the bipolar type and the transmitter is built in a cast brass shell of great strength and solidity.

Fig. 2 shows an intercommunicating wall telephone arranged for 10 stations.

FIG 1.—WALL SET FOR INTERIOR WORK.

FIG. 2.—INTERCOMMUNICATING WALL SET.

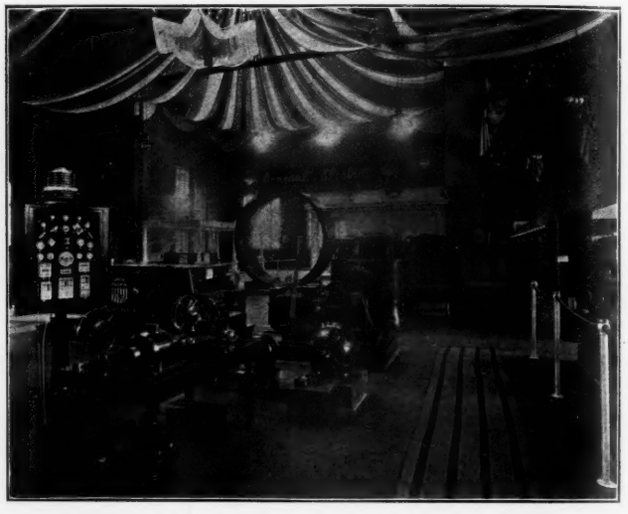
The operation of this instrument is apparent at a glance. It is stated that it makes no difference in what hole the plug has been left last, as any number may be called up immediately. All of the contacts on the hook are of platinum and the instrument is built with great solidity, as the illustration shows.

The General Electric Company at the Pan-American Exposition.

The General Electric Company has a comprehensive exhibit occupying the northwest corner of the Electricity Building. The principal feature of the exhibit is, of course, the 5,000-horse-power-transformer plant which transforms all of the current used by the exposition company in the lighting scheme of the building and the grounds. This transformer plant, which is practically a typical modern substation, occupies an important position among the various features of the exposition.

This company has confined itself to exhibits presenting a few of the most novel and recent developments in the practical field, showing such apparatus and appliances as have been perfected in the last few years and become recognized as of real importance commercially.

Model of the Schenectady Works, Pan-American Exposition.



View in the General Electric Company's Pan-American Exhibit.

One of the features of special interest in the exhibit is a complete installation of its series alternating enclosed arc lighting system by means of which the entire interior of the Electricity Building is lighted. Niagara power is taken from the transformer plant in the company's space and used to operate a synchronous motor which is belted to a 100-kilowatt, revolving-field, alternating-current generator and exciter combined. This generator furnishes current for the standard 75-light constant-current transformer, which operates two circuits of 35 enclosed arc lights each. This installation is complete with standard switchboard panels and is a most interesting illustration of the practical operation of this modern system.

The compensated type of generator, which is one of the company's most recent productions in the development of alternating-current apparatus, is so connected that it illustrates the interesting fact that this machine automatically maintains accurate voltage regulation under all the varying conditions of inductive and non-inductive loads.

The C. R. regulator is placed in the primary circuit of the transformer and is used to illustrate in a very practical manner the use of this form of regulation. Thus the most modern method of generating and controlling alternating current is shown in practical operation. While referring to the compensated type of alternator, it is of interest to examine the 200-kilowatt generator of this class which is exhibited. It is unique in design; it is a 36-pole machine of the revolving-field type and has an exciter mounted on the pillow block operated from the generator shaft by gear and rawhide pinion. This machine illustrates a construction which has been successfully used on large machines of different capacities with considerable success. It is designed for direct-coupling to the engine shaft, but is here shown with the separate pillow block where the engine bearing would ordinarily be. The series alternating system attracts a great deal of attention and in order to thoroughly illustrate the operation of these transformers the company has installed a small transformer having glass sides to permit full examination of the interior of the transformer while in operation. This small transformer operates two or three arc lights and series incandescent lights on the same circuit—thus illustrating the flexibility of this system which permits the use of arcs and incandescents in series.

One of the most interesting of the modern developments in lighting is the series incandescent street system which is shown in practical operation by means of a small reactive coil with the series incandescent lamps mounted on a panel beside it. These lamps may be cut out by means of small switches, thus enabling one to watch the operation of the reactive coil and the effect on the other lamps remaining in the circuit.

Visitors looking for information on arc lamps find a most interesting and novel display. This comprises a group of standard interchangeable type arc lamps, arranged with glass casings surrounding the mechanism and very dense inner globes, which permit a full examination of the arc without any strain on the eyes. By this arrangement, the lamp may be turned on and off and the entire working of the lamp mechanism may be observed under various conditions of the arc. These lamps form an interesting group in themselves, as they show to what extent the interchangeable idea has been carried by this company in arc lamp manufacture. There are shown three multiple lamps for 110 volts alternating and direct current and 220 volts direct current, respectively; and three others for series alternating, series direct constant current and 500-volt railway work. All of these lamps use the same outer and inner globes and each of the two groups mentioned is so nearly similar in construction as to convey the impression to the layman that they are alike. As a matter of fact, the difference between these lamps is only in three or four parts, which are in themselves interchangeable. The development of enclosed arc lighting has been carried into the constant direct-current field. For this work a very popular machine is undoubtedly the large type Brush arc generator with multiple circuit attachment, by means of

which a number of different circuits may be operated from one machine—one of these machines of 125 lights capacity is exhibited.

Visitors looking for information on electrical railway motors will find here an actual working example of the train control system of this company with two General Electric 66 railway motors and controllers representing all the apparatus required for operating a single car by the company's system of train control. It illustrates in a practical manner the fact that this system applies equally well to one car or to several in one train. The company's sectional third-rail system is also fully illustrated by an actual installation of contact rails and sectional switches. The contact shoes are so mounted on small wheels that they may be moved along the rails and the various conditions of the operation of this system fully understood.

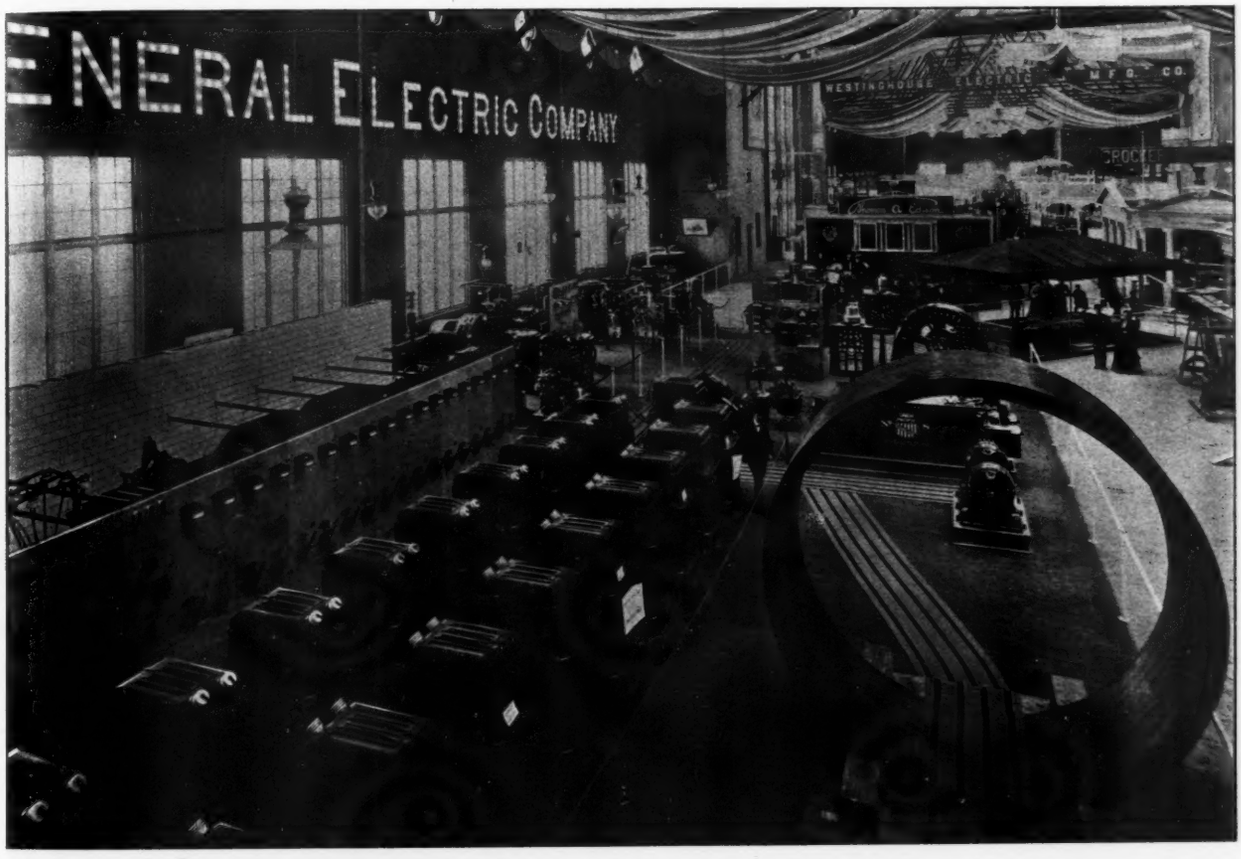
One of the popular features of the Electricity Building is the four-motor car equipment with electric brakes shown in this space. Two standard trucks for each electric car are shown supporting a platform on which are supported all of the devices of a standard car equipment. The trucks are operated by four General Electric 67 58-horse-power motors, with electric brakes. These are operated by two B-19 controllers located one at each end of the frame on the trucks. Current is taken from a section of grooved trolley wire which is actually installed with various line material made by this company. An interesting fact is here illustrated that when the motors are running at full speed, the trolley may be pulled down and then when the electric brakes are thrown on the wheels come immediately to a standstill, thus showing that these brakes work independently of the trolley circuit.

Electric air compressors are now being used by so many roads that this company now manufactures them and has shown a standard type, known as C. P.-12, operatively connected. The fact that compressed air is so useful for cleaning about car houses is practically illustrated in the space, where this method of cleaning and dusting is used.

The latest form of railway motors of various capacities manufactured by the company is also shown in its space. The wide use of standard appliances has necessitated the development of a wide range of instruments, switches, etc., for use on switchboards of all classes of electrical work and it has made a most interesting exhibit of this material. Of course, the large switchboard in the transformer plant, comprising of both high and low-tension panels with the oil-break switches, is of exceptional interest, but this switchboard being in service during all the open hours of the exposition, renders it difficult for visitors to inspect the fittings as fully as they may desire. The same may be stated of the several switchboards for different apparatus in the working part of the company's exhibit. Therefore, this company has made a special exhibit of switchboard appliances on blue Vermont marble panels conforming in design to the standard switchboards. This contains samples of each of the various types of measuring instruments made by this company with recording wattmeters, frequency indicators and other notable appliances of recent development. There are switches and circuit-breakers of various designs for high and low-tension work, and an oil break switch being arranged so that the fullest examination may be made. One of the company's new cabinet panels is also shown.

The line of small motors is indicated in the display of alternating and direct-current motors for various apparatus, many of them being operatively connected to machines of various types for household and shop use. The exhibit also contains a motor-generator set of the type extensively used for charging automobiles.

The company furnishes a great deal of material for mines; notably, mining locomotives and motors for mining pumps and mining hoists. Considerable attention is attracted by the 10-ton mining locomotive shown. This is a standard locomotive and of a type widely used, the one shown being already sold to the Union Pacific Railway, to whom it will be delivered after the exposition closes. The hoist and the pump are the latest designs and fully equipped with the company's motors and controlling devices.



General View of the General Electric Company's Exhibits at the Pan-American Exposition.

A Model Telephone Manufacturing Plant.

The business of manufacturing telephones is not unlike other manufacturing industries as they have recently been developed, in that it calls into play the service of specialized men and specialized machines for the construction of its product; and that factory which, other things being equal, shows the greatest degree of specialization and standardization makes the best and most popular outfit.

In the accompanying illustrations are shown a number of scenes in the factory of the Eureka Electric Company, Inc., of Chicago, one of the few companies which manufactures telephones in all their parts, beginning with the raw material of rough boards and castings. The building is well situated in the manufacturing district of Chicago, and is occupied in its entirety by the Eureka company.

In Fig. 1 is shown a corner of the plating room, wherein all of the bright metal parts and parts finished in nickel on the company's telephone apparatus are plated and finished. Before going to this room the parts have to be cleaned of adhering dirt and grease, and after leaving it also generally have to be polished. This work is done in the room, a portion of which is shown in Fig. 2, wherein the buffing lathes are located.

Figs. 3 and 4 give glimpses of the machine room and the switchboard assembling room, respectively. Each of these rooms is 150 by 50 feet in size. In the former, special engine-lathe and punch-press work is done, as well as a large variety of screw machine and special machine work, such as jig drilling and filing and grinding.

Here also are manufactured transmitters and switchboard parts which are assembled in the room shown in Fig. 4. This department is the scene of the assemblage of the various varieties of switchboards manufactured by the company, there being five standard varieties with many subordinate variations. In the illustration switchboards in various stages of construction are shown. Those who are familiar with telephone switchboard work will readily understand that in no department of manufacture is more exquisite care necessary than in handling the numerous small parts which go to make up the highly complicated structure of a modern board. The men in such a department have, of necessity, to be experts and specialists trained in skill by long experience in this particular class of work.

The assembling room shown in one of the illustrations occupies about one-half of the third floor of the factory and has a total output of 200 telephones per day. From this department the finished apparatus goes to the shipping room, where it is boxed for shipment or for storage as the case may be.

In the transmitter and winding department magnets are wound and the transmitter parts are assembled. In the same room also the telephone cords are finished, and this department is naturally one of the busiest in the factory. The illustration well shows the transmitter assembling department in the background with the cord finishers at work in the foreground to the right. Other illustrations show the receiver department and magnet room and the stock room wherein is carried a general supply of the many varieties of stock necessary for such a factory.

On the lower floor of the building are situated the offices of the company and in the basement is an engine and dynamo room equipped with a 500-incandescent-light dynamo and engine. This isolated power plant runs the whole factory by

1.—Electroplating Baths. 2.—Buffing Wheels.
3.—Aisle in Machine Room. 4.—Switchboard Assembling Room.

Views in a Modern Telephone Factory.

electric transmission, making the entire establishment self-contained and a single producing unit. It is interesting to note that for the last three years, or since the factory started in operation, none of the large force of hands employed in the factory has been dropped from the payroll for lack of work to keep them busy, but on the contrary the number employed has steadily increased through this period.

Report of the Law Committee, A. C. A.

The Law Committee of the Automobile Club of America recently issued a little pamphlet giving the results of its work during the past six months on behalf of the rights of automobilists. The first work of the committee was done in securing the passage of the Gasoline on Ferries Bill, which amended the United States statutes governing the carrying of gasoline on ferries or other harbor vessels. After that bill was passed the committee devoted its attention to heading off hostile legislation in New York state by the adoption of the amended Doughty bill, known as the Automobile Liberty Bill, for securing uniform legislation throughout the state with respect to the minimum at which local courts may fix the speed of automobiles in their respective districts. In the pamphlet the law is analyzed and its different sides contrasted, besides which the automobilist is acquainted with his rights and duties under the new law.

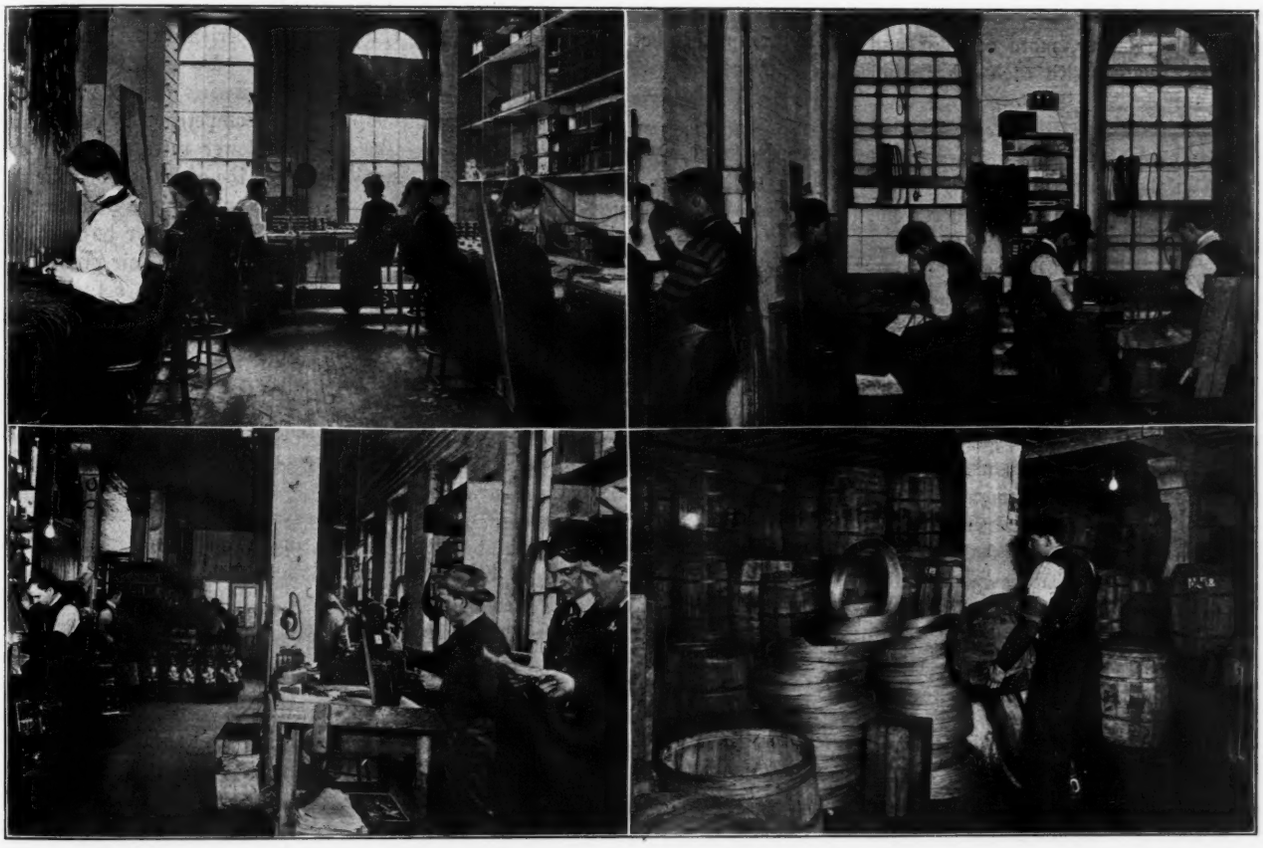
The Cost of an Elevated Electric Railroad.

A report from Philadelphia, quoting one of the group of banking interests regarding the cost of installation, equipment and maintenance of an elevated electric road, says:

"We had one of the best firms of engineering experts in the country figure for us, within a year or so, on the cost of building an elevated road in Philadelphia, and the estimate for the structure and full equipment with third-rail electric system was $2,000,000 per mile. This did not include property damage claims. Undoubtedly one could be built for less, but a plant like Manhattan would not suit modern requirements. Capital might be interested in an elevated line in Philadelphia, but we made up our minds we did not want to undertake it. Excepting Manhattan, which has a peculiar advantage in geographical location, for long-distance travel, a receivership has been the experience of the elevated lines."

Electric Baggage Cars in New York.

It has been announced by the New York Electrical Vehicle and Transportation Company, through its president, Mr. Henry Sanderson, that a new parcel delivery system will be accomplished soon by the introduction of electric trolley baggage cars which will be run over the lines of the Metropolitan Street Railway Company in the boroughs of Manhattan and Bronx. Arrangements have been completed by which the Electric Vehicle company obtained control of the recently organized Metropolitan Express Company, which had a contract with the Metropolitan company for running express cars over its trolley lines under conditions that would not interfere with the regular passenger car service. These cars are to be run over the lower avenues of the city after nightfall, when the various thoroughfares are not congested with traffic, and will be equipped to use the same underground current, and also to connect with the Union Railway Company's lines in the Bronx, where the overhead trolley system prevails. It has thus been found possible to devise an express delivery of baggage and parcels from the incoming railroads, from the department stores, and other sources of supply. Already 10 express cars are ready to run over the trolley lines until the new organization is complete.



5.—Transmitter and Cord Department.
6.—Corner of Receiving Department.
7.—Magneto Assembling Room.
8.—Construction Supplies Storeroom.

Views in a Modern Telephone Factory.

BELL METHODS.*

BY E. B. FISHER.

One of the most serious criticisms I have had occasion to suggest as to independent telephone companies is their lack of system, their lack of carefully analyzing conditions and experiences and their making systematic deductions therefrom. They have engaged in the telephone business, in too many cases, much as the original Bell corporation did, and have been learning from sad personal experiences, rather than from profitable observation of what had already been "threshed out" in the evolution of the Bell system. It is highly essential, now that the independent systems are becoming larger, more complex and intimately related with each other, that thorough system shall obtain; that first-class construction shall be the rule rather than the exception; that uniformity of practice in the manner of toll service, in the division of revenue arising therefrom, shall obtain; that those conducting the business shall exchange experiences, thus enabling all to learn of mistakes and avoid them, and to secure the advantages of improvements that may be devised. The exchanges of the Bell company throughout the country have for years enjoyed this interchange of opinion and experience, and through the manifest advantages of such interchange have avoided many difficulties and secured many betterments. We can and should copy this feature. We should meet each other frequently, individually and collectively, should keep in touch with each other by correspondence as well as over the wires—when we hear of a good thing, let our neighbors know of it; when we discover perils or uncomfortable conditions, warn our friends. The Bell, in a sense, although composed of many subordinate companies, has been one family. We can retain our individuality, maintain our ambition to be the first in our chosen sphere of action, and still remember that we are a part of a family. Some have been inclined to suggest that our friends of the Bell company had too much system. As the business develops, it begins to appear that too much system is less expensive and less foolish than too little. If the managers and operators of independent plants shall more carefully and fully analyze the cost of conducting their business in the different departments and the results therefrom, many errors will be avoided and the ledger balance on the right side will unquestionably grow. In systematizing business we have much to learn from Bell methods. We should gain this knowledge and improve on it.

I well remember when, a little more than six years ago, we began canvassing in Grand Rapids, Mich., to secure the moneys with which to build the plant of the Citizens' company and for patrons of the same, the many stories which were afloat among our people as to our business. It was confidently asserted by representatives of the Bell interest in our city and state, that we never would build a telephone plant—indeed, that we had no intention of so doing and were only trying to make money by being bought out. Even after we had actually begun to install telephones, those who had given us contracts were prompted to bet that we never would give service. There were infringement suits which may have been really expected to put a quietus on our enterprise, but these did not any of them succeed—it scarcely seems possible that some of them could have been expected to.

We have been giving service for more than five years and the company which was then organized with but $100,000 authorized capital, has grown until it has to-day in service more than one-half as many telephones as the Bell had in the entire State of Michigan but five years ago, and has an authorized capital well toward one-half what the Michigan Telephone Company then had. And yet to-day similar predictions and commentaries upon like enterprises, even in Michigan as well as other states, are indulged in by our neighbors. Officials of the Erie company have informed the public through the press within a few weeks that the new independent plant will never be built in Detroit; that the People's company in that city never will give service. When, in your respective localities, the Bell resorts to such methods to dissuade the public from patronizing them, to persuade them that you are not intending genuine business, you can comfort yourself with the fact that you are not singular in this experience, and you can point to results in other localities, and say to your friends, "It is an old story, and no truer here than it has been elsewhere."

If you get started with service and you find that your patrons receive circular letters suggesting that the Bell is owner of letters patent "steen hundred thousand and steen," and that all who use the independent apparatus infringe such letters patent and are liable to prosecution for using the same, do not flatter yourself that in this method the Bell company is distinguishing you beyond other independent companies. Such things have been done repeatedly You have yet to hear of a subscriber who has been so prosecuted, and you can very safely guarantee your patrons against any damage that may be awarded by any court under such suits, and that you will pay all costs for defense. If you should find that the Bell company, which has frequently informed the people in your community that their former rates were the lowest they could afford to make for their service in your locality, has, upon the development of your competition, resorted to free service, or much less than cost rates in an effort to destroy you, do not be fearful that such practice can really damage your company; do not imagine that you are enduring an experience novel in the telephone business. Do not, for a minute, when the Bell resorts to this method attempt to meet competition by establishing like rates, or lower rates, for your own service. Begin the education of your people; take them into your confidence; tell them the truth about your business and its results; insist upon a fair profit, upon reasonable returns on the actual investment, after giving good service, and you will find the people ready to pay your price rather than to get absolutely free service from the competitor. Do not resort to other tactics, because there can be but one result from such procedure. The company which shall reduce its rates below a reasonable point in a struggle with the Bell company is doomed the moment it shall do so.

What do you think of party-line service? One of the methods of the Bell company, in its efforts to meet the lower rates of independent telephone companies, has been to introduce, quite largely, party-line service with important reductions in rates for such service. Has it been successful where you have observed it? Is it a serious menace of the competitor? Of course, we know that the new president of the Central Union and the Chicago Telephone companies, who still retains his position at the head of the Pacific Coast company—all Bell—is a staunch advocate of this sort of service. He is a gentleman of extended experience and wide observation in telephony, and for that reason his opinion is not to be lightly dismissed, or treated with indifference. We are this morning discussing Bell methods in the hope that we may learn from them and profit from either accepting or avoiding their example. My own observation has been that party-line service is largely " a snare and a delusion" where given in city exchanges, and is not a competition that we need fear. It is evident that no devices have yet been

*Abstract of paper read before the Independent Telephone Convention, Buffalo, June 12, 1901.

invented which will permit more than two parties to use the same line at the same time, so when any pair on the party line holds the line, others must wait. Should this sort of service be generally used, the difficulty of securing your own line and of getting connections with other parties on similar lines is manifestly very greatly increased. We all know how impatient the average telephone user is to get service the moment it is wished—you have known subscribers ready to swear that the girl kept them waiting two minutes for a connection when it was not to exceed 20 seconds. I do not believe that you will be compelled to resort to party-line service to meet this method of the Bell competition. The B. W. C. service which was expected to work wonders three or four years ago is not very generally popular.

No discussion of recent Bell methods would be useful if we did not consider minute rates for toll service. What is your observation on this topic? The high authority from the Pacific coast who is trying to stifle competition in the Central Union territory and to prevent it in Chicago, who is, indeed, regarded as a possible head of the American Telephone and Telegraph Company, is the father of the minute-rate service. He sets great store by his scheme and has secured its adoption in considerable territory outside of that which he controls. We, in the Michigan territory, find it one of our competitors, and have not quite made up our minds as to its present and probable effects. However, on general terms, it is fair to state that it is causing considerable friction and dissatisfaction. The average telephone user is ready to affirm that he has not used the service so long as he has been charged for. He considers himself a victim of overcharge, and believes that the minute rate is intended to thus increase the fees of the telephone company which he was inclined to believe were already quite large enough. If the average business man, on a long-distance connection, can actually accomplish his conversation in a single minute, it strikes me that at the price for one minute's connection the line can not earn enough; for we all know that quite as much time heretofore has been spent in getting two parties to talking as is occupied with their conversation. Now, if the time for securing connections can not be reduced and the time of using is reduced, with theoretical reduction of pay, service would be less profitable to the companies than on the three or the five-minute basis. If the average subscriber is expected to use the line on a three or five-minute basis, why not make rates upon that theory? That would be fair to both company and patron, and secure the desired revenue, even if but one minute should actually be used. The purpose of this paper, as before stated, is to set you to talking about your mutual experiences and to induce discussion rather than to state conclusions.

In Michigan our neighbors have taken a new departure within the last few weeks. Formerly they refused to admit that any other apparatus than the Bell could be successfully used in telephone service. The sub-companies of the parent company were supposed to have a hard and fast contract forbidding the use of any other apparatus and forbidding connections with any other apparatus. Latterly, the Michigan Telephone Company have been attempting to secure, in a few instances, toll-line alliances with companies formerly built and still continued, as far as exchanges are concerned, as independent companies. The Michigan company has said, in effect, to such companies: Keep your local exchanges, even your own toll lines; take control of the exchange business in your locality, but enter into a contract for toll connection outside your territory through the Bell system; it will give you equal percentages on originating business to those you have heretofore enjoyed and provide you with more extended and superior toll-line facilities. This late Bell method is insidious, and it is not strange that in some cases it is successful. Where such a contract is made exclusive—and, of course, they try to make it exclusive if possible—it subtracts by so much from the efficiency of adjoining or neighboring independent service. So anxious has the Michigan Telephone Company become in this matter, I believe it is true that it has been willing to make arrangements, in some cases, for a divided toll service where it was impossible to secure an exclusive contract. This Bell method is one of the most threatening efforts yet made, and yet has its silver lining. The strong independent companies, with considerable toll-line facilities—which have been growing—have not been influenced by such propositions. Only the smaller and weaker companies have made such contracts with the Bell company. Of course, no other independent company has been willing to parallel the lines of a neighboring independent company, no matter how inferior might be such neighboring plant, or how imperfect its service. Now that sort of territory will be provided with up-to-date independent plants. This recent manifestation would seem to indicate that the parent company must have consented to an abandonment of the exclusive feature of its contract with subordinate companies.

I believe that the Bell habit of ignoring the farmers—the small villages and the country—has been an error. I think that in this department of telephone service, a proper development of party lines may be made with great advantage to the communities served and at fair profits to the investor. There are regions in Michigan—and probably each of you could repeat the same tale—where the Bell is beginning to compete with independents in their own field in this regard. I say their own field, because the independents were the first to deliberately provide this sort of service. This Bell method of following a good example may prove a formidable competition and may materially strengthen their smaller exchanges and their situation if they shall first enter new territory with this sort of service.

There was a time when I think it was actually believed by the average general manager or prominent official connected with the Bell telephone companies that an independent company could not possibly secure intelligent, experienced employés. They thought that we would be compelled to go through the process of evolution which was so tedious and so costly in the earlier days of the Bell company; that their employés would remain with them; they even thought in some localities that an independent company could not get exchange operators, and in some instances employed superfluous help simply to keep them from entering the service of independent competitors. Some know more to-day on this topic than they did a few years ago. A large number of the brightest men in telephony have found employment in the independent field, and there is scarcely one in this convention hall who has not had frequent opportunity to secure many more of the most important employés of the Bell company than he has had places for. We have been surprised at times at the seeming lack of loyalty to their employers by those who have been so long on Bell payrolls. Perhaps a little analysis of Bell methods may explain this situation and furnish a warning for ourselves. The rewards among the employés of the Bell heretofore have not been great either in salary or opportunities.

If you should wake up some fine morning and hear that you have sold or are about to sell your telephone plant to the Bell company, do not consider that the transaction is necessarily closed. If you

hear similar reports as to actual or impending sales of other independent companies in your own or other states, be not disturbed thereat, nor convinced that the news is reliable. There have been some such sales, but vastly more rumors of those which never have occurred and do not seem likely to. There have been methods in these rumors; for some reason, some interest, evidently not independent, has believed it desirable to circulate such reports, probably in the hope that other independent interests might be disquieted or discouraged, and yield more readily to apparently advantageous offers. These methods have been relied upon to produce serious effects. Keep yourself and your neighbors advised of the strength and growth of the independent movement, of the strength of their own situation in competition, and fewer such rumors will be verified hereafter.

In nothing that I have said thus far have I given many of you real news. As I said to one of my friends, I felt that it was impossible to do so, and was almost ashamed for having tried to prepare and read such a paper; but if it shall refresh your memory, if it shall induce you to give other experiences and observations of your own; if it shall attract, through publication in our annual reports or otherwise, the attention of any who are about to engage in the telephone business, and shall hearten and strengthen them in their enterprise and efforts, it may accomplish some of the good earnestly desired and intended in the preparation of the paper. As stated at the outset, it is not in criticism or derogation of the Bell company that it is offered. That corporation has the right to resort to any efforts, within the bounds of fact, it may choose to make, and we have equal right to discuss its methods, and by considering them minimize their effects, if not entirely to overcome them. It is in this spirit of consideration only that this paper is offered.

New Office Building for the General Electric Company.

A new office building, which will measure over 200 feet in length and more than 100 feet in width, is going up in Schenectady, N. Y., for the General Electric Company, which has recently made many additions to its immense plant in that city. The new building will be five stories high, of brick and terra-cotta, and equipped with the most modern appliances for heat, light, ventilation and other sanitary requisites. Its cost is estimated at $250,000.

Visual Signal Telephone Apparatus.

The visual signal telephone switchboard, manufactured by the Electric Appliance Company, has been very carefully worked out to take its place in general telephone construction. The old type of drop or

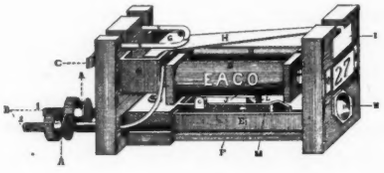


Fig. 1.—Combined Jack and Signal.

falling shutter has been entirely eliminated from it and the visual signal used throughout. The jack and signal, which are self-contained and self-restoring, occupy a front space on the switchboard of one inch by one and one-quarter inch, which is claimed to be smaller than any other. This combination is shown in

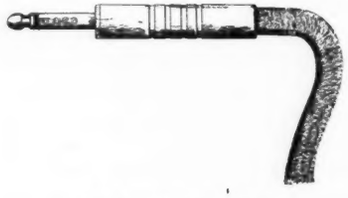


Fig. 2.—Eaco Plug.

about half its actual size in one of the accompanying illustrations.

The entire construction of the signal is with hard rubber insulation, and platinum contacts are provided throughout in the ringing and listening key circuits. The plug, which is also shown in one of the illustrations, is so constructed that no brass parts are exposed on the outside, thus making it impossible for the operator to receive a shock. The sleeve of this plug is grooved on the outside and is made of highly polished, tough, black fibre. The sleeve screws on to the body of the plug

Electric Soldering Iron.

and is not fastened from the outside with a machine screw in the usual way.

The clearing-out drops are of the long tubular type armored with a soft iron covering made by boring out solid Norway iron rods. It is stated that cross-talk is entirely eliminated by this construction. The drops are wound to a resistance of 500 ohms, and are bridged on the cord circuit.

When a subscriber rings up, the current passes over the screw, B1, Fig. 1, to line spring, C, through the signal coil, DD, over drop contact spring, E, which makes contact with the line connection, F, which is connected to the other line screw, B2, energizing the cores of the signal and attracting the armature, G. This raises the latch, H, in view, having the plate, I, attached to the end, which is painted red. This plate, I, normally lies behind the number plate, 27. The gravity lock spring, J, locks the armature in a permanent position, which keeps the signal plate, I, in constant view until restored by the operator inserting a plug.

When the latch, H, is raised in position the springs, KK, which normally do not make contact, are pressed together by a piece of fibre which is attached to the latch, H. The springs, KK, form the night-bell circuit and are entirely insulated from the signal coils and frame by the fibre. When a plug is inserted into a jack after the signal plate has been raised, the tip of the plug strikes the fibre tip, L, which is fastened to the lock spring, J, releasing the armature, G, which allows the latch, H, and plate, I, to restore to their normal positions.

When the plug is fully inserted the tip of the plug makes contact with the spring, C. When the tip of the plug moves the spring, C, the drop contact spring, E, is moved by the fibre button, N, breaking the drop connection between spring E and line contact F. The base, F, and the ferule, M, are connected together and form one part of the line circuit.

The signal, as shown in Fig. 1, is in a position showing that the subscriber wishes to be answered. All parts of this combined signal and jack are removable.

Electric Soldering Irons for Telephone Work.

For work on a telephone switchboard nothing is more satisfactory than an electrically heated soldering iron, which not only keeps at exactly the proper temperature but is far safer than any flame-heated apparatus in such situations. The accompanying illustration shows an iron made by the American Electrical Heater Company, of Detroit, Mich., especially for switchboard work. These irons are made for any voltage up to 125 volts, weight 15 ounces, are 13 inches long and consume 90 watts. A tip extending four or five inches beyond the end of the iron can be used if desired, and the apparatus may be plugged to any convenient lamp socket.

Current Electrical News

Commercial News

EXPORT AND DOMESTIC

The Siemens & Halske Electrical Company, of Berlin, has decided to issue a loan of 5,000,000 marks at four and one-half per cent. The issue price will be 100.

A company with large capital is being organized chiefly in New York for the purpose of absorbing the local electric street car lines, water company and the electric light and gas companies of Omaha, Neb.

It is reported that a syndicate, headed by Messrs. R. D. Apperson, of Staunton, Va., and F. H. Shelton, has just secured control of the Lynchburg & Rivermont Street Railway Company, the Lynchburg Electric Railway and Light Company, and the local gas company in Lynchburg. The two former properties have been consolidated under the title of the Lynchburg Traction and Light Company. Mr. Apperson has been elected president and general manager of the new company, and Mr. Shelton secretary and treasurer. Both of these gentlemen are well known in financial circles. They control the Petersburg Gas Company, of Petersburg, Va., and the Columbus Gas and Light Company, of Columbus, S. C. Mr. Apperson will also remain manager of the Staunton Light and Power Company, of Staunton, Va.

Work will be commenced in a few days on the mammoth dam to be built across the Big Muskegon River at Croton, Mich., 10 miles west of Howard City. When completed this will be one of the finest pieces of masonry of its kind in Michigan. It will be of stone and mortar, 250 feet in width with a height of 48 feet 6 inches. It has been designed on the latest and most approved plans of dam building. The Muskegon River Power Company, which is erecting the structure, has received several propositions, including the lighting and furnishing of power for the towns of Newaygo, Fremont and Grant; for the proposed Grand Rapids, Sparta and Newaygo electric line; the Muskegon Valley electric line, and others. It is expected that when completed this dam will be the means of revolutionizing the power and light problem of Howard City and the vicinity.

Electrical illumination for church edifices is said to be increasing very rapidly, and an instance is cited in a daily contemporary of a new church uptown in New York on the west side which runs its own dynamos by means of a 25-horse-power gas engine. The dynamo is supplemented with a storage battery which takes care of the lights in the Sunday-school room, rectory and adjacent buildings. Electricity also operates the motor that pumps the organ bellows and turns the ventilating fans. While the dynamo in itself is nearly noiseless, it was thought best by the church officials to avoid any possibility of noise or annoyance to the church members by not running the machine during service, supplying light and power instead from the storage battery, by means of which all the light and power needed in the building are available at any hour of the day or night without recourse to the dynamos.

The annual meeting of the Fall River Automatic Telephone Company was held May 27 in the company's new Exchange Building. The following board of directors was elected: B. D. Davol, E. B. Jennings, R. P. Borden, C. S. Greene, R. J. Thompson, V. A. Sears, R. F. Haffenreffer, J. W. Coughlin, M. Sweeney. B. D. Davol, treasurer; R. P. Borden, clerk. The company has very nearly completed its underground system, which is designed for 3,000 subscribers. The automatic switchboards, furnished by the Strowger company, of Chicago, are being connected up. The exchange will open for business in July, and will be the largest automatic telephone exchange, at that date, in the world. The population of Fall River is 104,000. The same system has been in successful operation in the adjoining city of New Bedford (population 60,000) for six months. Its advantages lead to its use in Fall River. The two cities, 14 miles apart, will be connected with toll lines.

Statistics published by the *Elektrotechnische Zeitschrift*, of Germany, show that on September 1, 1900, 99 German cities had electric railways. It is estimated that on January 1, 1901, 107 cities were so supplied. In 1891, the number of such cities was three; in 1895, 32; in 1899, 88. The last year has also witnessed a very large extension of existing systems. On September 1, 1900, the length of track was 1,793 miles, against 1,280 miles in 1899. The number of motor cars was 5,994 (4,50. in 1899) and of attached cars 3,962 (3,138 in 1899). The aggregate power of the electrical machines was 75,608 kilowatts, against 52,509 kilowatts in 1899. The power of the accumulators was 16,890 kilowatts (13,532 in 1899). The system of overhead conduit is used almost universally. The combined system of overhead conduits and accumulators has not been satisfactory. Three cities—Berlin, Dresden and Düsseldorf—have short lines with underground conduits (2.1 miles in all). Only three lines use accumulators exclusively.

The syndicate of Baltimore, Md., capitalists, which recently purchased the San Francisco, Cal., & San Mateo Electric Railroad, are said to be negotiating for the Santa Clara Electric Railroad, the Alum Rock Motor Line, the Electric Improvement Company and the San José Light and Power Company. Messrs. J. L. Blackwell and G. R. Webb, of Baltimore, who are at the head of the eastern syndicate that proposes extensive developments along the California peninsula, were in San José recently to inspect the plants of the power, lighting and street railway companies. The plans of the company involve a consolidation of the two electric companies for the purpose of economy and continuous rapid transit on the west side of the bay from San Francisco to the road leading to the Lick Observatory from San José, a distance of nearly 60 miles. If this project is carried through it may possibly change the entire drift of suburban population in the vicinity of San José and San Francisco.

The recently incorporated Richmond, Ind., Street and Interurban Railroad Company is formed of some of the wealthiest men in the state, with a capital stock of $500,000, $300,000 of which was paid in on the day of incorporation. The company recently bought the Richmond street railway system from the Union Trust Company, of St. Louis, and a new power plant will be built at Richmond, sufficiently large to supply power to the city plant and also to the road from Richmond to Dublin, 19 miles west, which will be built during the coming summer by the company. The road from Richmond to Dublin will be a part of the general system which will connect Indianapolis with Richmond and also with Dayton, Ohio. The officers and incorporators of the company are as follows: H. B. Smith, president; John W. Van Dyke, vice-president; Charles Murdock, secretary and treasurer; J. M. Lontz, assistant secretary; Perry Freeman, local attorney. The policy of the company will be to pay cash for everything and no indebtedness will be incurred or bonds issued.

Personal Mention

MR. JAMES MALLEN has been elected president, and Mr. George W. Corden, secretary and treasurer of the Rising Sun, Northeast & Elk River Electric Railway, Light and Power Company.

PRESIDENT K. KIKUCHI, of the Imperial University of Tokio, Japan, will officially represent that institution at Yale University during the latter's bi-centennial at New Haven, Ct., next October.

DR. KARL AUER VON WELSBACH, the inventor of the mantle gas burner, and a distinguished scientist, has been created a baron by the Emperor of Austria, in recognition of his important scientific work.

PROFESSOR H. J. VON HOFF, of the University of Berlin, Germany, began the delivery of a limited number of lectures on physical chemistry at the Kent Chemical Laboratory of the University of Chicago on June 19.

MR. ALFRED F. MOORE, of Philadelphia, the head of the well-known insulated wire manufacturing house, was a New York visitor last week, a guest of Mr. Henry L. Shippy, with whom he went yachting from the Olympic Club, Long Island.

PROFESSOR ARTHUR A. NOYES was recently awarded a grant of $300 by the Rumford Committee of the American Academy of Arts and Sciences, to aid him in his researches on the effects of high temperatures upon the relative conductivities of aqueous salt solutions.

MR. EDWARD WHITAKER has resigned the presidency of the St. Louis, Mo., Transit Company, Mr. Murray Carlton, first vice-president, succeeding him. Mr. Whitaker's reasons for resigning were that his personal interests are so great that he could not give sufficient attention to the interests of the railway company.

PROFESSOR JOSEPH AMES, who was formerly associate professor of physics in the Johns Hopkins University, will now have full charge of that department, succeeding the late Professor H. A. Rowland. Professor R. W. Wood, of the University of Wisconsin, has also been appointed to the staff of the Johns Hopkins University in the Department of Physics.

MR. T. S. McMANUS, manager of the Southern Bell Telephone and Telegraph Company, of Wilmington, N. C., recently left his offices to be absent about three months, in order to superintend the construction of a toll line for the company between Spartansburg, S. C., and Asheville, N. C. The line is to be part of the circuit between Atlanta and Charlotte. While Mr. McManus is away Mr. S. H. Dozier, of Charlotte, will be the company's local manager.

MR. W. L. CANDEE, managing director of the Okonite Company, New York, and Mr. George A. McKinlock, president of the Central Electric Company, Chicago, sailed for Europe on Thursday of last week, on the Deutschland. They expect to be gone in the interest of their companies for about a month. Mr. McKinlock came East without expecting to make the trip, but the agreeable accommodations on board the great transatlantic steamer were such that he promptly decided to join his friend in making the voyage.

Electric Lighting

The city of Spencer, Iowa, has purchased the electric lighting plant for $15,000 and will extend the service.

Contracts for the new power-house for the Boston, Mass., Navy Yard have been let, the price being stated as $42,000.

An electric lighting plant and waterworks to cost in the neighborhood of $40,000 are soon to be built in Tompoc, Cal.

A bond issue of $25,000 has been authorized by the authorities of Chillicothe, Mo., to provide for an electric lighting plant.

A by-law to have the city install a system of waterworks and take over the electric light plant at Midland, Ontario, has been adopted.

The Bellevue, Ontario, city council has accepted the tender of the Trenton, Ontario, Electric Company, to supply the city with electric light.

It has been decided by the Frankfort, N. Y., Electric Light Company to enlarge and extend its plant and service greatly for electric lighting in that city.

New Orleans, La., is contemplating a municipal electric lighting plant, and has appointed a committee of three to investigate the matter and prepare plans.

An increase to its capital stock has been made by the Mattoon, Ill., Heat, Light and Power Company, in order to provide for tensions and improvements to its plant and system.

The Bristol, Tenn., Gas and Electric Company has been purchased by Mr. P. J. McDonald, of New York city, who will act as president and general manager of the company.

A public electric lighting plant is proposed for Atlantic City, N. J., and engineers are to be employed to estimate the cost. The city council believes that such a plant will save the city money.

A small electric lighting plant is soon to be constructed in Middletown, N. Y., and it is believed that it will be in operation in the near future. Construction work is to begin in a short time.

Contracts have been awarded for a building for the plant of the Shamokin, Pa., & Coal Township Light and Power Company. The building will be completed about October 1, at a cost of $70,000.

The Royal Electric Company's contract for lighting the city of Montreal, Quebec, expires December, 1903, and tenders are now being called for on a new contract. Specifications are now out.

A bond issue of $18,000 has been recently voted by Frankfort, N. Y., for the purpose of building a municipal electric lighting plant. Work will be begun as soon as plans and specifications can be prepared.

The plant of the Provincetown, Mass., Electric Light Company is expected to be finished and in operation by September 1. The company is reported to have contracts for 625 lighting installations for private parties.

Contracts for electric lighting, aggregating between $25,000 and $30,000, will be let at the next meeting of the city council of Sharpsburg, Pa. The money will be spent for enlarging and improving the borough's electric light and water plant.

On June 28 the stockholders of the Riverside, Cal., Power Company, will meet to consider the question of issuing $250,000 in bonds for constructing a new power and electric lighting plant. Particulars may be had of Mr. J. H. Barbour, secretary.

A $30,000 bond issue was recently made by Winchester, Tenn., to provide for the proposed electric light plant and waterworks; bids for the construction of which will soon be called for. The engineers in charge are Messrs. Kirkpatrick and Johnson, of Jackson, Mich.

The electric lighting plant which will furnish illumination only for the business district is now being constructed in Terre Haute, Ind. The plant will have a capacity of from 3,000 to 4,000 arc and incandescent lights. No house lighting will be attempted by the company.

A state electric lighting plant for the capitol buildings in Madison, Wis., has been provided by a bill which passed the state senate recently. By the terms of the bill the Governor is authorized to contract for the construction of such a plant at a cost of not more than $35,000.

A new electric lighting company known as the City Lighting Company has been formed in Wilkesbarre, Pa. The company's claim to recognition is that it will furnish illumination at 20 per cent less cost to the consumer than is now charged by companies already in the field.

It has been decided by the city of Atlanta, Ga., that the Atlanta Railway and Power Company and the Georgia Electric Light Company must remove all their overhead wires and place them underground. This decision affects all the traction and lighting companies in that city.

The public library of Toledo, Ohio, will, in all probability, be electrically lighted some time during the coming summer. Estimates have been prepared which call for from 200 to 500 lights, and the matter is now in the hands of a committee which will be authorized to obtain bids.

An electric light plant is soon to be built in Winchester, Tenn., in connection with the city waterworks. The upset price for the plant, which will be owned by the city, is placed at $30,000, and five per cent, 30-year bonds to that amount have already been issued by the city authorities.

Contracts for the new electric lighting plant in Nashville, Tenn., have been awarded, the bid price being $86,823. The contract calls for the usual steam equipment of a first-class plant, while the electrical apparatus will be furnished by the Bullock and Wagner electric manufacturing companies.

The private electric lighting plant installed for the purpose of illuminating the two principal hotels in Sioux City, Iowa, has been finished recently, and is expected to save its customers at least $5,000 a year. The machinery of the new plant cost $10,000, which it is believed will be recovered inside of two years.

An electric light plant is to be erected at the forks of the Walla Walla, Wash., River by the Athena Electric Light and Power Company. The falls are 12 miles from the city of Walla Walla, and power and electric lighting will be furnished throughout that city and a number of the neighboring towns as well as to consumers throughout the rural districts.

An electric lighting company has been formed in Middleport, N. Y., by local business men for the purpose of erecting a plant to furnish light for the village. A plant will be built at a cost of about $32,000, and work is to be begun in the near future. The officers of the company are: President, F. A. Dudley; secretary and treasurer, L. S. Sterrett.

An electric lighting plant is being constructed to light the stations along the tracks of the Chicago terminals of the Illinois Central Railroad between Flossmoor and Randle street, Chicago. Incandescent and arc lights will be used to light the stations and about the yards. The generating station which is now being constructed to maintain the light plant will be located on Twenty-seventh street, Chicago.

Reports from Los Angeles, Cal., state that the Edison Electric Light Company in that city has increased its capital stock from $1,250,000 to $2,000,000, the increase being due to the absorption by the company of the Redlands Electric Light and Power Company. The transfer of the Redlands property to the Edison company has been consummated and the purchaser will install improvements at once at a cost of about a half million dollars.

The People's Lighting Company, of Los Angeles, Cal., is again attempting to secure a franchise in that city for electric light conduits and gas mains under the streets. The company is said to be financed principally by Chicago capital. Its previous applications for franchises were unsuccessful and have been withdrawn. The company is said to have assured the city that it is willing to spend at least $25,000 the first year, and put up a $10,000 bond as a guarantee.

A city lighting and power plant is soon to be built at Santiago de Cuba with a capacity of 240 arc lights and 6,000 incandescent lights. Two hundred horse-power will be furnished to small consumers in and about the city. At first the plant will be steam driven, but later on power will be transmitted from the Guaso River waterfalls, about 75 miles distant, where there is an available head of 600 feet, and which can develop a minimum of 1,500 horse-power in the dry season.

By the sale of the plant of the Fulton, N. Y., Electric Light Company to some unknown corporation, which is believed to be the Westinghouse Electric and Manufacturing Company, the lighting situation in Fulton is somewhat complicated, and no one in the town knows exactly wnat sort of service will be inaugurated by the new company. The sale is said to have been made by the old company on condition that the purchaser grant the town as sufficient and satisfactory a service as has been maintained heretofore.

Delay in securing construction material and poles has prevented the Citizens' Gas and Electric Light Company, of Council Bluffs, Iowa, from carrying out its lighting contract with the city on time. The delay is stated to be due in part to the action of the city officials, at whose request the company changed its pole line, thus necessitating considerable extra work and placing of an entire new set of poles. All the wire now employed on the company's commercial circuits is to be discarded and entirely new lines will be strung. The current will be received and transformed down from the Omaha power-house.

One of the most remarkable electric lighting plants in the State of Missouri, and probably in all the United States, is that of the American Electric Power Company. The plant is situated in the back yard of Mr. Edward Field Goltra, who resides in St. Louis, the proprietor being E. F. Goltra, Jr., who is president of the company, all the members of which are his friends and playmates, not one being over 10 years of age. Some time ago the boys started to study electrical engineering and were permitted to experiment. A little later the house was connected for electric lights by one of the large local lighting companies, when the boys stepped in and by exercising their "pull" managed to get the contract away from the corporation, securing it for themselves. It is said that the service rendered by the boys' plant is satisfactory, and that the experiment so far has been a success.

Electric Railways

The Cleveland, Elyria & Western Railway Company will be extended this summer from Oberlin to Norwalk, Ohio.

A new power-house is to be erected by the Waterville & Fairfield, Me., Light and Power Company during the coming summer.

A franchise has been granted to the Tiffin & Sandusky Electric Railway Company to build its lines in Seneca County, Ohio.

A franchise has been granted by the town of Verona, Pa., to the Wilkinsburg & Verona Street Railway Company to enter that town.

The new power-house of the Wilmington City, Del., Railway Company, is soon to be built on the Brandywine River, at a cost of $21,000.

Construction work on the proposed electric railway between Paris and Clinton, Ind., will probably be started by the end of July. The line will be about 20 miles long.

The capital stock of the Boston, N. Y., Terminal Electric Railroad has been increased to $1,500,000 and its bonds to $1,200,000 to provide for an extension of the road to Amsterdam.

Work has been begun on the construction of the extension of the Nassau Electric Railroad in Union street, Brooklyn, N. Y. There was much opposition on the part of residents of Union street.

A 25-year franchise has been granted by the commissioners of Portage, Ohio, to Messrs. J. A. Blackburn and G. W. Taylor for a street railway from Garrettsville to the Trumbull County line. Construction work will soon be begun.

Pasadena, Cal., will have two electric railways in the near future. The two roads will be affiliated with the Los Angeles Electric Railway Company, and the new route running between the two cities will reduce the time about 35 minutes.

Construction work was begun on the electric power plant of York Haven, Pa., on June 1. It is estimated that from 25 to 40,000 horse-power can be generated from the water pressure now going to waste at the falls in that city.

The electric railway between St. Mary's and Piqua, Ohio, by the way of Sidney, is now assured. The contract for the construction of the road has been let and the road will be in operation January 1, 1902. Almost all the right of way has been procured.

Construction work on the lines of the Sandusky & Southwestern, Ohio, Electric Railway Company is to be begun in a few days. The company will also operate an electric light and power plant, which will be erected near the steam railway tracks in Tiffin.

An electric street railway is soon to be built in the city of Sidney, Cape Breton, and at a meeting of the Cape Breton Electric Company which was held on April 17, sufficient capital was subscribed to make the building of the road within the year a certainty.

Construction has been begun on a Pennsylvania trolley line at Ashtabula, Ohio. This road will be an important link in the system of electric roads now being built, and before the close of the summer it will probably be possible to go by trolley cars from Cleveland, Ohio, to Erie, Pa.

The Mineola, Hempstead & Freeport, L. I., Traction Company has obtained from the trustees of Hempstead a franchise to build an electric railroad through that village to connect with the proposed line to Queens. The company will commence the work of construction before August 1.

The Indiana Street Railway Company announces that the work of building an interurban line from South Bend through Niles and Berrien Springs to Benton Harbor, with a spur west from Niles to Buchanan, will be commenced within a month, and that cars will be running through Niles by August 1.

The Buffalo, Hamburg & Aurora, N. Y., Railway Company is reported to have given up its plan of extending its line to East Aurora, having chosen a more feasible route. It is expected that the company will assume control of the Birmingham & Ebenezer electric road, extending it from the latter place to East Aurora.

Des Moines, Iowa, will soon be a centering point for an extensive system of interurban railways. Probably the first line to be built will be run from Des Moines to Nevada and Eldora. Another line will run to Creston and Winterset, anotner to Indianola, another to Newton, and others to Grand View, Charles City, Greene and Parkersburg.

Electric railways in Sofia, the capital of Bulgaria, says *Le Tramway*, are being vigorously exploited, and a new enterprise is a Franco-Belgian company which possesses the greater part of the capital for the construction of the lines. The Bulgarian newspapers have hailed the project with applause and the people are reported to have given it a very warm welcome.

In Leipzig, Germany, every street car is reported to contain copies of a bi-weekly newspaper called the *Leipziger Strassenbahn Zeitung*, a medium which contains advertisements, railroad time-tables, notices of theatrical performances and jokes. The papers are fastened on racks which are hung on hooks in the corners of the cars, and the passengers are privileged to take the papers down and read them while in transit.

The New York city syndicate which recently purchased the San Francisco & San Mateo, Cal., Electric Railroad planned considerable extensions to suburban points and construction work will soon be begun. A large amount of money will be spent on the line, and it is believed that the extensions planned will aid materially in building up the suburban points in the two cities named.

A trolley line will be built between Williamsport, Pa., and Lock Haven, a distance of 24 miles. The line will pass through a populous farming community and the towns of Linden, Jersey Shore, Oak Grove and Chatham's Run. Among the incorporators are State Senator J. Henry Cochran, ex-Attorney-General H. C. McCormick, and Judge Charles Mayer, of Lock Haven. The company has been capitalized at $150,000. Senator Cochran has been elected president.

A method for getting more accurate readings and saving breakage when making temperature tests on motors on its cars has been adopted by the electrical department of the Brooklyn, N. Y., Rapid Transit Company, which has fitted up its testing kits with small incandescent lamps. Each lamp is placed on the end of a handle in which are contained a few cells of storage battery. In front of the lamp is placed a lens so that when a button is pressed on the handle a strong light is thrown on the thermometer scale, which can be read with ease while it is in position.

The Salem, Ore., street railway lines and the electric light plant, formerly owned by the Salem Light and Traction Company, have passed into the hands of the London & San Francisco Bank, on foreclosure sale, the bank bidding $144,000 for the property. It is understood that the bank will invest some $50,000 in improving its property. For several years the property did little more than pay expenses, but with the return of better financial conditions the plant is apparently a paying institution. The change in title resulted in no change in the local management.

Automobile Notes

A company has been formed in San José, Cal., with $100,000 capital to build automobiles under the patents of Charles E. Christman, of Los Gatos. California oak is to be used in constructing the bodies of the vehicles.

A new use has been found for automobiles in France at the race course at Auteuil. When a horse is injured in the steeplechase, a specially constructed motor vehicle is brought up, the injured animal placed in it and transported to the nearest veterinarian.

Participants in the Paris-Berlin automobile race, which will take place in the week of June 22 to 29, have been appointed the following route: June 22, Paris to Reims; June 23, Reims to Luxembourg; June 24, Luxembourg to Coblentz; June 25, Coblentz to Frankfort; June 26, Frankfort to Eisenach; June 27, Eisenach to Leipzig; June 28, Leipzig to Potsdam; June 29, Potsdam to Berlin.

Plans are well under way for an automobile stage line which will run across New York city on Sixty-sixth street, its object being to connect the Sixty-sixth street station of the Ninth avenue elevated with the Sixty-seventh street station of the Third avenue line. The line is to be run through Central Park over the Converse road which connects Sixty-sixth street east and west. Five vehicles will be run.

The Harvard Auto Corporation of Boston, Mass., was recently organized to establish a chain of automobile stations between Boston and New York, five having been already put into service. The system is intended to enable any automobilist who regularly stores his machine at any station of the chain to receive accommodation at any other station, while any repairs or supplies he may need are merely charged back to his home station at the usual rates.

Lieutenant-General Miles, commanding the United States Army, has expressed himself strongly in favor of automobiles for telegraph repair-wagons in the field and in various other connections for the army service. With the object of ascertaining such a type of automobile, Major Maxfield, of the Signal Corps, was recently ordered to Elizabeth, N. J., and Tarrytown, N. Y., to conduct an investigation, the result of which, when completed, he will submit to General Miles.

An alderman in Brooklyn, N. Y., recently introduced an ordinance at a meeting of the local board of aldermen for the adoption of a fender for automobiles, making the neglect to comply with the statute an offense for which the owner must pay $25. It has been suggested by the frivolous press that the same good effect would be obtained if the aldermen were compelled to wear fenders, and lights by night and bells by day. The suggested fender is of about the same pattern as that used on trolley cars.

Honolulu, H. I., is reported to be more enterprising than San Francisco or any other Pacific coast cities of the United States, with the exception of Los Angeles, for the former city has a completely equipped automobile service, which operates under the name of the Hawaiian Automobile Company, Limited. Its equipment consists of about twenty hacks, five runabouts, one surrey and one tally-ho. For 25 cents one may take an automobile and ride from the business centre of Honolulu to almost any part of the city, while for half a dollar the tourist may enjoy a ride through the suburban and rural districts. For trips through the purely business section of the city two passengers can ride for one 25-cent fare.

Telephone and Telegraph

A new line is soon to be built between Onawa, Ia., Moorhead, Soldier, and other near-by towns in Monona County.

A franchise has been granted by the city of Elmira, N. Y., to the Century Telephone Company for a system in that city.

Franchises are asked for by two new telephone companies in Springfield, Ohio, both desiring 25-year permits with the usual privileges.

Reports from Rome, N. Y., state that the Northern New York Telephone Company has sold its entire system to the Hudson River Telephone Company. Consideration, $100,000.

Contracts have been let for the new exchange of the Hudson River Telephone Company, in Albany, N. Y. The building will be of brick, four stories high, and will cost $50,000.

The Independent Telephone Company, of Austin, Tex., has recently purchased a building for its central offices and exchange in that city for $10,000. A full equipment will be installed.

Amended articles of incorporation have been filed by the Dubuque Telephone Company, of Iowa, which will extend its lines into the rural districts of Dubuque County and over into Illinois.

A consolidation of the independent telephone companies in London and South Charleston, Ohio, has been effected and the new organization is known as the Madison-Clark Telephone Company.

The Schuylkill Valley Telephone Company, of Reading, Pa., has awarded a contract for the Reading switchboard, plant and 1,000 instruments, the exchange to be finished by October 1.

Construction work on the new Davenport, Iowa, and Omaha, Neb., telephone line has been begun, and the line will be built by the Trans-Mississippi Telephone and Telegraph Company, of Des Moines.

Mr. C. S. Palmer, receiver of the Standard and Central Mobile Telephone companies has been ordered by the courts to sell those companies at auction in default of judgment held against them by local capitalists.

New lines are to be built by the People's Telephone Company, of Detroit, Mich., and it has been decided to string new metallic copper lines to Lowell and Newaygo immediately to accommodate the increasing business.

The Hancock, Del., Telephone Company, of which Mr. Chester B. May is principal owner, has been merged in a stock company with a capital stock of $3,000. Among the directors are: Messrs. E. J. Cotter, H. W. Wagner, C. B. May and others.

The Redkey, Ind., Telephone Company has been recently incorporated for $10,000, and will operate exchanges and systems in Jay, Wells, Randolph and Blackford counties. Its directors are Messrs. D. R. Smith, C. C. Mills, B. W. Whitehair and others.

A petition has been circulated by the citizens of Dickson, Tenn., by which the Cumberland Telephone and Telegraph Company is requested to permit the whole of Dickson County to talk with the exchange in that city free of message cost to the patrons.

It is stated that the Western Electric Telephone company has purchased the Green & Western Company's telephone system, which includes 450 miles of toll line and exchanges at Mason City, Charles City and Osage, Iowa. The consideration is stated to be $100,000.

At a recent joint meeting of the Newport News and Richmond telephone companies, held at Yorktown, Va., it was practically decided to consolidate the two systems. Each organization will keep its name and corporate existence, but the subscribers will use only one instrument.

Reports from Des Moines, Iowa, state that the entire business of the Central Telephone Company, of that city, has been sold to the Jasper County Telephone Company with headquarters at Newton. The former company has operated 31 telephone stations in central Iowa from Boone to Oskaloosa.

A company has been organized in Cleveland, Ohio, to construct a complete telephone system in El Paso, Tex., and if the plans for the new system materialize successfully the promoter, Mrs. Annie Brett, will build a line to Chihuahua, Silver City, N. M., and another along the Santa Fe road to connect with the Colorado lines.

Important extensions to its lines are planned by the Western Telephone and Telegraph Company, of Camden, N. J., which expects to maintain exchanges soon in Gloucester City, Woodbury, Cape May, Burlington and Atlantic City, connecting there with Jersey City. Connection will also be made with the Keystone Telephone Company, of Philadelphia.

The bill recently introduced into the New York Legislature to give the telegraphers of the Police Department the rank and salary of sergeant has been passed, and under that statute each one of the telegraph operators gets considerably more pay than formerly, and enjoys more privileges than many other equally skillful telegraphers outside of the municipal employ.

The new People's Telephone Company, of Detroit, Mich., is an independent organization, and its corporation certificate is to be filed as soon as the necessary signatures have been attached to it. The company's capital will be fixed at $2,500,000, seventy per cent of which is owned by the Everett-Moore syndicate, of Cleveland, Ohio, while the remaining thirty per cent is held in Detroit.

Negotiations now being carried on will shortly result in the formal consolidation of all the lines of the Fox River Valley, Wolf River and Little Wolf River Telephone companies thus making the strongest independent telephone company in all the Northwest. The name of the consolidation will be the Fox River Valley Telephone Company, and its headquarters are to be established at Appleton, Wis.

It has been announced that the Chicago & Milwaukee Telegraph Company will transmit messages between these two cities at the rate of 10 cents for 10 words and one cent for every additional word whenever such messages can be delivered by telephone in either Milwaukee or Chicago. It is also stated that no arrangement has been made for the delivery of such messages except by telephone, but they will be mailed to the addresses if they can not be otherwise reached.

Consolidation of all the telephone systems in northwestern Louisiana has recently been effected, the merger comprising the Baton Rouge, Thibodeaux, Teche, Vermillion and New Iberia exchanges and systems, which cover a territory of 200 miles. The corporation will have a capital stock of $250,000, with its main office at New Iberia, and will be known as the Louisiana & Texas Long-Distance Telephone Company. Mr. R. F. Hoggsett is president and general manager; H. G. Giles, secretary and treasurer, and S. H. Lancaster, general superintendent.

New Incorporations

JAMESON, MO.—Jameson Telephone Company. $3,500. Incorporators: A. J. Fuller and others.

INVERNESS, FLA.—Florida Telegraph and Telephone Company. $250,000. Incorporators not named.

KINGSTON, N. Y.—Kingston Auto-Electric Fire Alarm Company. $30,000. Directors: I. M. Block and others.

SYRACUSE, N. Y.—The Syracuse Lighting Company. $2,500,000. Directors: C. V. Nellany, H. F. Ives, R. F. McKiniry.

BUTLER, DEKALB CO., IND.—The Butler Telephone Company has increased its capital stock from $10,000 to $25,000.

NEWARK, N. J.—Essex Electric Company. $700,000. Incorporators: W. C. Clark, Simon Scheuer, R. H. McCarter and others.

LOS ANGELES, CAL.—Ventura Water, Light and Power Company. $500,000. Directors: J. H. Adams, F. E. Trask and others.

OSKALOOSA, IOWA—Oskaloosa Home Telephone Company. $100,000. Directors: H. H. Evans, W. D. Dunsmore and M. Shisser.

INDIANAPOLIS, IND.—Western Indiana Railway Company. $100,000. Directors: C. Fairbanks, F. A. Joss, F. A. Woods and others.

GLENS FALLS, N. Y.—Hudson River Electric Company. $1,000,000. Directors: J. M. Warren, F. G. Baker, H. W. Williams and others.

AURORA, ILL.—Elgin, Aurora & Southern Traction Company. $2,000,000. Incorporators: L. J. Wolfe, F. B. Bicknell and H. Grenebaum.

DEFIANCE, OHIO—Defiance, Ottawa, Kenton & Columbus Interurban Railway. $50,000. Directors: D. J. Ryan, G. H. Jones and H. H. Fisher.

NORTH AUGUSTA, S. C.—North Augusta Electric and Improvement Company. $1,500,000. Incorporators: J. V. Jackson, Henry Buist, A. S. Elliott.

WATERVLIET, N. Y.—Watervliet-Green Island Home Telephone Company. $225,000. Directors: S. B. Rawson, F. H. Sudro, T. M. Brush and others.

PORTAGE, WIS.—Sauk County Traction and Power Company. $10,000, with privilege of increase. Incorporators: T. Hamilton, H. Green and T. P. Carter.

PORT CLINTON, OTTAWA CO., OHIO—Port Clinton Home Telephone Company. $40,000. Incorporators: R. S. and H. A. Barber, J. S. Brailey, Jr., and others.

JERSEY CITY, N. J.—Butte Electric Light and Power Company. $2,500,000. Incorporators: W. J. Canning, C. R. Dean, C. E. Esterbrook, T. K. Henderson and William Mansfield.

DES MOINES, IOWA—Trans-Mississippi Telephone and Telegraph Company. $100,000. President, J. W. Hill; vice-president, F. C. Hubbell; secretary, C. C. Deering; treasurer, M. McFarlin; manager, A. T. Presson.

LOUISVILLE, KY.—Citizens' Lighting Company. $1,000,000. Directors: A. Harris, C. R. Huntley, T. E. Murray and others. Indebtedness limited to $5,000,000. This company is a consolidation of the Citizens' General Electric Company and the People's Electric Light Company.

Electrical Securities

The financial situation is quite favorable. Money is plenty here and abroad. The crop conditions are improving. The railroad earnings show increase upon increase. Bank clearings over the land, leaving New York as a speculative centre quite out of reckoning, prove that an enormous general business is being done. Our foreign trade is stupendous, an increase of over $11,000,000 in exports being shown last month as compared with May of last year, this sum also representing an increase of $18,500,000 over May of 1899.

The increase in our exports for the fiscal year to date is $999,000,000 over last year; and it is now almost certain that our exports for the entire fiscal year will be $1,500,000,000, breaking the record.

ELECTRICAL SECURITIES FOR WEEK ENDING JUNE 15.

New York:	Highest.	Lowest.	Closing.
B'klyn R T	82¾	79⅛	81⅛
Con. Gas	224	218	223½
Gen. Elec	248½	241	248
Man. El.	124⅝	117⅝	123¼
Met. St. Ry	175½	170	175
Third Ave R. R.	123	123	123
Kings County Electric	...	...	200
N. Y. & N. J. Tel. Co.	...	...	180
Telep.. Tel & Cable Co.	...	...	6¼

The Western Union Telegraph Company has declared a quarterly dividend of one and one-quarter per cent, payable July 15. The company reports for the quarter ending June 30—the figures this year being partly estimated, while those for last year are actual:

	1901.	1900.	Changes.
Net revenue	$1,750,000	$1 600,926	Inc. $149.074
Interest	239,048	223.945	Inc. 15.094
Balance	$1,510,960	$1,376,981	Inc. $133 979
Dividend	1,217,001	1,217,000	Inc. 1
Surplus	$293,959	$159,981	Inc. $133,978
Prev. surplus	9,012 895	8,298,224	Inc. 714,671
Total surplus	$9.306,854	$8,458,205	Inc $848 649

It is probable that the stock of the American Telephone and Telegraph Company will be listed on the New York Stock Exchange at an early date. This will undoubtedly add 25 per cent to the market value of this stock, as the New York banks will accept it more favorably as collateral.

The position of the stock of the Brooklyn Rapid Transit has greatly improved in recent years and it is expected that dividends will soon be commenced. There is a satisfactory increase of net carnings.

The consideration of the franchise tax cases has exerted a depressing influence on Metropolitan Street Railway. It is said to be the plan of this company to send through cars from end to end of Manhattan Island and to the various ferries and put a stop to the annoying transfers.

The American Telephone and Telegraph Company announces that it will issue to stockholders 207,090 shares of new stock at par, $100 per share. Each stockholder is entitled to one share of new stock to every three of the old. Payment of one-half must be made by August 1, 1901, and the remainder by January 15, 1902.

The *Wall Street Journal* states that the business on the books of the General Electric Company is sufficient to keep its plants in full operation for two years. It further states that the matter of a thirty-three and one-third per cent stock dividend is to have early consideration as soon as President Coffin and other leading officials return from Europe.

The Manhattan Railway Company has declared the regular quarterly dividend of one per cent.

The Westinghouse Electric and Manufacturing Company has declared a quarterly dividend of one and three-quarter per cent on its preferred stock, payable July 1.

Chicago, June 15:

	Closing.
Chicago Edison Light	177
Central Union Telephone	34
Chicago Telephone	275
Un. Trac.	19
Un. Trac. pf.	60
Metropolitan El.	93

Central Union Telephone is practically the only weak feature among the Chicago stocks during the week just closed. There are numerous small stockholders whom it is thought will not be able to pay the assessment of $60 per share, but the Bell people, who own 51 per cent of the stock, will be able to do so and undoubtedly will authorize the extensions and improvements which President Sabin has recommended.

The American Steel and Wire Company has declared one and one-quarter per cent dividend on the common stock. This will direct attention again to the value of the subsidiary companies of the United States Steel Corporation, whose earning powers, we believe, are not yet fully appreciated by the purchasing public.

Chicago Edison has reelected the former directors and officers and voted to increase the capital stock from $6,000,000 to $10,000,000.

Boston, June 15:

	Closing.
Am. Tel. and Tel.	153
Erie Tel.	57
New Eng. Tel.	142
Mass Elec. pf.	94⅛
Westing. Mfg. pf	77
Edison Elec.	260

The Manchester Traction Light and Power Company, controlling the electric light and street railway interests of Manchester, N. H., has declared its first semi-annual dividend of three per cent, payable July 15 to stock on record July 5.

It is calculated that 100 shares American Telephone stock can be procured, through the purchase of rights, for $148.28 a share.

Philadelphia, June 15:

	Closing.
Elec. Co. of A	8¾
Philadelphia Elec	5¾
Union Traction	26
United G. I. Co.	117
Elec. Sto. Bat. c.	55
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The papers to be sent out, officially announcing the American Railways Electric Company of America deal, have been printed and now await the filling in of the dates, which will be done upon the completion of the examinations now being made.

The consolidation of the Philadelphia Company and the Consolidated Traction Company, of Pittsburgh, will soon be consummated.

The United Gas Improvement Company has declared the regular quarterly dividend of two per cent, payable July 15 to stock of record June 29.

Educational News

THE UNIVERSITY OF WISCONSIN, at Madison, has received an appropriation of $30,000 from the state legislature for the equipment of the new building for its College of Engineering.

A TECHNICAL SCHOOL for boys is soon to be erected in New York city by Mr. Abraham Steinman as a memorial to his son, Lucas A., at a cost of $100,000. When established, the school will be under the supervision of the Hebrew Technical Institute.

THE INTERNATIONAL CORRESPONDENCE SCHOOLS, Scranton, Pa., were recently visited by Messrs. K. Yonekra, chief engineer of the Hakkaido Coal and Railroad Company, Japan, and K. Kamio, electrical engineer of the same company, and Arnold Shanklin of the National Cash Register Company, Dayton, Ohio, who came to inspect the schools and their system.

Legal Notes

REVOCATION OF FRANCHISE RIGHTS—By a verdict of the Supreme Court of Minnesota the Erie Telephone Company retains its full franchise rights in the city of Minneapolis. Suit was brought by the city to revoke certain of the company's rights to erect poles and string wires in the city. The lower court decided in favor of the city. Upon appeal, the Minnesota Supreme Court reversed the decision of the lower court, deciding that such rights can not be revoked.

CONSTITUTIONALITY OF ACT OF REDUCING WASHINGTON TELEPHONE RATES—The Court of Appeals of the District of Columbia on May 21 affirmed the constitutionality of the Act of Congress of 1898, reducing by about 40 per cent telephone rates in the city of Washington, thus reversing the judgment of Justice Barnard of the Supreme Court of the District of Columbia. The telephone company refused to reduce its charges to the rates fixed by the act, alleging it unconstitutional for the reason that it interfered with chartered rights and the service could not be performed at the prices fixed. An appeal will probably be taken by the telephone company to the Supreme Court.

Obituary Notices

MR. C. S. COX, a well-known correspondent and illustrator of technical journals, recently died suddenly at his home in New York.

MR. MARTIN H. WATT, late secretary of the Montreal, Quebec, Street Railway Company, died in that city recently. He is survived by a widow.

MR. A. H. ROE, whose name is connected with the service of the P. & O. Steam Navigation Company as a sea-going electrical engineer, recently died at his home in Bury St. Edmunds, England, where, as the borough electrical engineer for the past year and a half, he successfully inaugurated the electrical illumination of that town.

PROFESSOR JOHN A. VIRIAMU JONES, professor of physics of the University College of South Wales, died recently in his forty-fifth year. Professor Jones's career as a physicist was exceedingly brilliant. His scientific work was mainly concerned with the absolute measurement of resistances, and he was a member of the British Associations Committee on that subject. He accomplished much for the cause of technical and scientific education in Wales and other parts of great Britain.

PROFESSOR T. HENRY SAFFORD, one of the most prominent of contemporaneous American mathematicians and astronomers, died at his home in Williamstown, Mass., on June 13. He was a very remarkable mathematician and attracted much attention by his powers when a boy. In 1866 he was appointed director of the Astronomical Observatory of Chicago, and from 1869 to 1871 was engaged upon the great catalogue of the stars then in preparation by the cooperation of the American and European astronomers. In 1876 he was called to the chair of astronomy of Williams College, which chair he held until his death. He was associated with the American Academy of Sciences and a number of various foreign organizations of similar character, besides being an author of note.

Industrial Items

THE PERU ELECTRIC MANUFACTURING COMPANY, of Peru, Ind., reports large shipments of Pemco rosettes and is a firm believer in the theory that it pays to advertise a good article.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is sending out a most complete catalogue of telephone and annunciator systems for hotels, factories, apartment buildings. It will be sent upon application.

THE AMERICAN BRIDGE COMPANY, New York, N. Y., has contracts for furnishing two deck-plate girder spans for the Nacozari Railroad Company, of Mexico, and a cantilever bridge over the Colorado River for the Atchison, Topeka & Santa Fe Railroad.

THE STANLEY ELECTRIC MANUFACTURING COMPANY at Pittsfield, Mass., has moved its general offices and the engineering department into commodious quarters at the new works. Several of the other departments are also installed there and by the end of June the new works will probably be completely occupied.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., is mailing a neat little folder which sets forth the advantages of the company's electric fans, and invites any one interested in such apparatus to call at the company's office and inspect the types of Emerson motors and fan apparatus on exhibition there. Another folder deals entirely with cuts, which will be furnished free to the company's customers who wish to advertise the company's product.

THE KEYSTONE CAR WHEEL COMPANY, of Philadelphia and Pittsburgh, Pa., which was organized in a new plant last September, has grown so rapidly that its present quarters are reported entirely inadequate for carrying on its rapidly increasing business. A large addition to the foundry has been ordered and when completed will make the entire plant the largest individual one east of Chicago. The company's specialty is car wheels for electric service.

AMERICAN ELECTRIC FUSE COMPANY, New York, Chicago and San Francisco, states that it has recently perfected a new telephone fuse, which is said to be the best on the market. In appearance the new fuse resembles the old style manufactured by the company, with the exception that it is enclosed between two pieces of mica, thus preventing the likelihood of breakage. Free samples will be sent to any inquirers, and it is stated that the fuse will fit any standard block on the market and will also be made in any shape or design required.

"THE THOROUGHFARE OF THE NATION." In a recent article on the growth of the traffic on the New York Central, the Rochester *Herald* says: "The New York Central may well be called the thoroughfare of the nation." This statement was brought out by the last census, which shows that of the people living in the cities of 8,000 or more inhabitants, more than one-half live along the New York Central lines; and of the people living in cities of 100,000 or more inhabitants, two-thirds live along the New York Central lines. These and other startling figures are given in No. 13 of the "Four Track Series."

THE NEW ROMANCE of "Three Men in a Vehicle," reprinted from the *Motor Vehicle Review* with other documentary evidence, is an account of a motor vehicle trip from Boston to New York in one of the carriages of the St. Louis Motor Carriage Company. The company is sending out the pamphlet with testimonial letters stating that the true test of a machine is its service in the hands of the public, and also stating that it can show many satisfactory letters from customers. Copies of the reprint will be mailed to any one interested on application to the St. Louis Motor Carriage Company, 1211 to 1213 Van Deventer avenue, St. Louis, Mo.

THE FALCON FAN MOTOR for direct current is one of the leading fan motors on the market. It is made in three sizes, 12, 15 and 18 inches, finished in black enamel with polished brass fan and guard. In operation this fan is noiseless and is provided with universal joint, which makes it adjustable to either wall or desk use. The Central Electric Company, of Chicago, is the agent for this fan motor and will be pleased to send to any one upon request the 1901 fan-motor catalogue describing the Falcon as well as numerous other fans, which include direct and alternating-current desk and bracket and ceiling fans, also battery fan motors.

THE E. W. BLISS COMPANY, Brooklyn, N. Y., manufacturer of power presses, is mailing its catalogue for the current season and states that its product consists of machinery and dies adapted to the uses of manufacturers of everything from agricultural implements to playing-cards and jewelry. Considerable attention is paid in the catalogue to electrically operated presses. The presses built by this company are well known and largely used throughout the country for the manufacture of armature disks, etc. They well sustain the excellent reputation of this house. Inquiries for catalogues, circulars or other information may be sent to the company's offices at Adams and Plymouth streets, Brooklyn.

THE DE DION-BOUTON MOTORETTE COMPANY, Brooklyn, N. Y., is making preparations to place upon the American market an eight-horse-power motor, which is stated to be a genuine De Dion-Bouton and which will be offered exclusively to the American trade. The company states that the success of its five-horse-power motor, which has been on the market for some time, insures the success of larger apparatus. As the tendency of both France, England and America is toward vehicles of higher power, the company will build the eight-horse-power motor to meet the demand thus created. This new motor will form part of the equipment for the new "Paris" type of motorette under construction at the Brooklyn works.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, has published two attractive bulletins covering fan motors and ceiling fans for direct and alternating current. The direct-current Peerless ceiling and desk fans of 1901 embody a large number of improvements both in inside construction and artistic outside designs. For alternating current this company offers the Emerson desk and ceiling fans. The style of these fans does not materially differ from last year's, but is practically the same, with the exception of a few improvements. Special attention is called to the Parker noiseless blades, with which all these fans are equipped. Catalogues and descriptive matter covering these fans will be mailed on application.

THE ELECTRIC VEHICLE COMPANY, New York city, states that one of its Columbia runabouts, equipped with the new Exide battery, recently made the trip from Washington to Baltimore on one charge, under conditions which made the run remarkable from the point of battery endurance. An automobile run had been planned from Washington to Baltimore for that day, but as the falling rain and heavy roads prevented the other vehicles from starting the runabout undertook the trip alone, the cyclometer indicating at the finish a run of 44 miles, eight miles of which distance were over roads that required an excessive amount of current to keep the vehicle in motion. At the finish of the run there was sufficient current left in the battery to carry the vehicle several miles around Baltimore, bringing the total mileage on one charge of the battery to 50 miles. No attempt at speeding was made on account of the heavy roads.

THE PENNSYLVANIA RAILROAD has issued a folder under the caption "Around the World," giving a complete list of passenger itineraries for the coming year, with a handsome map showing the routes selected and the points at which the company's guests will touch. Fourteen different tours are suggested, and the folder, which is intended primarily for use in Great Britain and Europe, is a veritable compendium of useful information for those who contemplate such a trip, while the map is an unusually handsome and accurate sample of the map maker's art. Particular emphasis is laid upon the choice of the route which includes Washington, D. C., inasmuch as that city is the national capital and because it embodies features of unusual architectural interest and is one of the handsomest centres of the country. The folder is handsomely illustrated with pictures and facsimiles of round-the-world tickets. It will be mailed to any one interested on application to the eastern passenger agent, Mr. Samuel Carpenter, at the New York offices, 1196 Broadway.

THE NORTHERN ELECTRICAL MANUFACTURING COMPANY, of Madison, Wis., through its Chicago office, has secured the contract for the entire equipment of the new central station being built by the Citizens' Electric Light Company, of Battle Creek, Mich. The installation will consist of one 275 and one 135-kilowatt, two-phase Stanley inductor alternators, together with station and substation switchboards, step-up transformers, etc. The large unit will be belted to a water-wheel of about 250 horse-power and the smaller one will be driven by a Buckeye engine. On account of the limited and uncertain water power available it will be necessary to operate these generators in parallel, the smaller unit taking its load automatically in proportion to the power of the water-wheel. This would mean that the water-driven unit will, at all times, carry the bulk of the load; the engine-driven unit only being called upon when the power of the water-wheel falls below normal. These conditions have been met and satisfactory results accomplished in many places equipped with Stanley apparatus.

THE BROWN HOISTING MACHINERY COMPANY, INCORPORATED, Cleveland, Ohio, is mailing the 1901 edition of its crane catalogue. The book measures six by nine inches and contains 240 pages, being practically an encyclopedia for crane users. It is characterized by unusually handsome half-tone engravings showing the company's cranes in actual operation in installations throughout the country, and it is stated in the introduction of the book that the illustrations shown are merely of the standard types of apparatus manufactured by the company, which is prepared to submit designs and prices on any changes from its standards or on cranes desired for particular work. It is further stated that it is impossible for a Brown crane to drop a suspended load by any means whatever, or in the case of hand operated cranes to injure a workman by the flying handles in lowering a load. Among the illustrations shown are the Niagara wheel pits, the city sewage canals at New Orleans, La., the pier heads along the water front at Chicago, Ill., various views of the steel companies in Pennsylvania and Ohio where the Brown cranes are extensively used, wrecking cranes on several different railways and a huge cantilever crane at the works of the Newport News Ship Building and Dry Dock Company. Particular care has been taken in preparing the book to make it not only useful as a catalogue but also interesting and attractive to the eye. Tables of full descriptive matter are given and the book is, taken altogether, encyclopedic in its character.